RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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CONTENTS

ANGIOCARDIOGRAPHY IN CONGENITAL HEART DISEASE OF CYANOTIC TYPE. III. OBSERVATIONS ON COMPLETE TRANSPOSITION OF THE GREAT VESSELS. *R. N. Cooley, M.D., and R. D. Sloan, M.D.* 481

DENTAL ROENTGENOLOGIC MANIFESTATIONS OF SYSTEMIC DISEASE. II. DEVELOPMENTAL DISTURBANCES. *Edward C. Stafne, D.D.S.* 507

ROENTGEN STUDIES OF THE MAXILLAE AND MANDIBLE IN SICKLE-CELL ANEMIA. *Irwin B. Robinson, D.D.S., and Bernard G. Sarnat, M.D., D.D.S.* 517

CHOLECYSTOGRAPHY WITH TELEPAQUE. A PRELIMINARY REPORT. *E. Frank Everett, M.D., and Leo G. Rigler, M.D.* 524

ROENTGEN MANIFESTATIONS OF LYMPHOSARCOMA OF THE STOMACH. *Paul H. Deeb, M.D., and Walter L. Stilson, M.D.* 529

EMERGENCY DIAGNOSIS OF UPPER DIGESTIVE TRACT BLEEDING BY ROENTGEN EXAMINATION WITHOUT PALPATION ("HAMPTON TECHNIC"). *Harvey C. Knowles, M.D., Benjamin Felson, M.D., Nathan Shapiro, M.D., and Leon Schiff, M.D.* 536

TWO UNUSUAL TUMORS OF THE DIAPHRAGM. *Marvin M. Keirns, Major, MC, USA* 542

TELEROENTGENOGRAPHIC PELVIMETRY. PRELIMINARY REPORT. *Donald R. Germann, M.D.* 548

INTRATHORACIC MENINGOCELE; A CASE REPORT. *Sidney Rubin, M.D., and Edward H. Stratemeier, M.D.* 552

THE COUNTRY RADIOLOGIST. PRESIDENTIAL ADDRESS. *John S. Bouslog, M.D.* 556

ABSORPTION OF 2-MEV CONSTANT POTENTIAL ROENTGEN RAYS BY LEAD AND CONCRETE. *W. W. Evans, M.S., R. C. Granke, B.S., K. A. Wright, B.S., and J. G. Trump, Sc.D.* 560

MONITORING OF A DIAGNOSTIC X-RAY DEPARTMENT. *Lillian E. Jacobson, M.A., Joel J. Schwartzman, M.D., and Saul, Heiser, M.D.* 568

EDITORIALS: RADIOLOGIC EXAMINATION OF THE OBSTETRIC PATIENT. *Robert P. Ball, M.D.* 583

NEW APPOINTMENTS TO THE EDITORIAL STAFF. 584

ANNOUNCEMENTS AND BOOK REVIEWS. 585

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES. 590

ABSTRACTS OF CURRENT LITERATURE. 594

RADIOLOGY

A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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Angiocardiography in Congenital Heart Disease of Cyanotic Type

III. Observations on Complete Transposition of the Great Vessels[1]

R. N. COOLEY, M.D., and R. D. SLOAN, M.D.

Baltimore, Md.

IN PREVIOUS PAPERS (6, 7) the angiocardiographic aspects of (*a*) the tetralogy of Fallot, including pseudo-truncus arteriosus, and (*b*) tricuspid stenosis or atresia with hypoplasia of the right ventricle have been presented. In this paper we shall describe the angiocardiographic findings in a series of 13 patients with proved complete transposition of the great vessels.

ANATOMICAL AND PHYSIOLOGICAL CONSIDERATIONS

Transposition of the great vessels is defined by Abbott (1) as "an alteration in the position of the two great vessels relative to the ventricles of the heart or to each other at their origin, so that they either spring from reversed ventricles, the aorta from the right and the pulmonary artery from the left chamber (complete transposition), or from the ventricles from which they normally belong, but in reversed relationship (corrected transposition)." We are concerned here only with complete transposition, in which the position of the great vessels is completely reversed in relation to the ventricles. Complete transposition associated with underdevelopment or absence of one of the ventricles is not considered. Transposition associated with tricuspid stenosis or atresia and underdevelopment or absence of the right ventricle has been previously discussed (7). Furthermore, instances in which one of the great vessels overrides the ventricular septum are not included.

Several theories (10) have been developed in an attempt to explain the origin of complete transposition. Although they are of considerable interest, none of them appears to be completely satisfactory and their influence upon the diagnosis and treatment of this condition so far has been negligible.

In complete transposition of the great vessels the aorta originates entirely from the right ventricle and receives systemic venous blood; the pulmonary artery originates from the left ventricle and receives highly oxygenated blood (Fig. 1). Thus in the usual case, where there is no significant rotation of the heart, the aorta is anterior and the pulmonary artery posterior in position. The unsaturated blood in the aorta is distributed to the systemic circulation and returns to the right side of the heart. The oxygenated blood in the pulmonary artery is distributed to the lungs and returns to the left side of the

[1] From the Department of Radiology, The Johns Hopkins Hospital and Medical School, Baltimore, Md. Accepted for publication in August 1951.

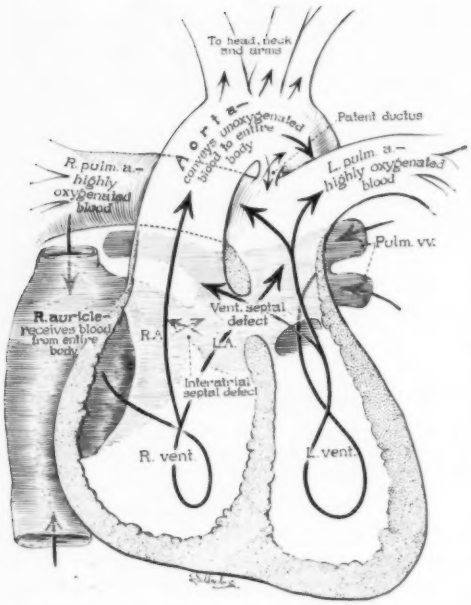

Fig. 1. Diagram of the heart and great vessels in complete transposition. All three commonly associated defects which may permit an exchange of blood between the two sides of the heart are shown.

heart. The two circulations are thus separate except for certain compensatory defects which must be present if life is to continue.

In a review of 123 proved cases of this condition, Hanlon and Blalock (9) found that the most common single defect was a patent foramen ovale[2] and the most common combination of defects was a patent foramen ovale plus a patent ductus arteriosus. Among the single defects, an opening in the interventricular septum was associated with the longest life span, but a combination of an interventricular septal defect and a patent foramen ovale gave an even greater average duration of life. The explanation for the increased life expectancy under these conditions is not entirely clear, but presumably an interventricular defect offers, as a rule, the best exchange of blood between the two sides of the heart.

It is obvious that a unidirectional shunt cannot be maintained for more than a short time without overloading one side of the heart. Consequently, if only one defect is present, there must be a periodic reversal of the shunt, dependent upon differences in pressure between the two circulations. With an increase in the volume of blood in one side of the heart, the pressure on that side tends to become greater and the shunt is thus reversed. The presence of two openings, such as an interventricular and an interatrial septal defect or an interventricular defect and a patent ductus, presumably would allow predominantly unidirectional but opposite shunts through the two defects and thus there would be less tendency for the two circulations to become unbalanced.

The pulmonary arteries and particularly the smaller branches in the lungs are usually considerably dilated, and their walls are secondarily thickened. These changes are more pronounced in older patients and are supposedly associated with the increased pulmonary artery pressure. Occasionally cases are encountered in which there is some degree of proximal pulmonic stenosis. In such instances the pulmonary artery pressure is reduced and the smaller branches in the lungs are diminished in size. The presence of this additional defect is thought to improve the results which can be expected from surgical treatment (3).

Where a sizable patent ductus arteriosus is associated with a complete transposition of the great vessels, significant amounts of highly saturated blood may enter the descending aorta from the pulmonary artery. Thus more highly oxygenated blood would be distributed to the lower portion of the trunk and lower extremities than to the head and upper extremities. A consequent difference in degree of cyanosis between the hands and feet may be visible and is a diagnostic sign of importance.

The coronary arteries receive highly unsaturated blood from the aorta, and the myocardium is consequently inadequately supplied with oxygen. This, combined with the distention secondary to the constantly reversing shunts, usually re-

[2] Indicates an interatrial septal defect.

sults in progressive cardiac enlargement. The right ventricle is often proportionately larger than the left.

DIAGNOSTIC CONSIDERATIONS

With transposition of the great vessels cyanosis is usually present from birth or very early life. Sooner or later it becomes persistent and then is frequently progressive. As a clinical sign, however, the cyanosis is not significantly different from that seen in many other congenital anomalies save for the previously mentioned variation in its anatomical distribution in association with a large patent ductus arteriosus.

Formerly it was thought that a life span greater than eighteen months was exceptional. It is now evident that a considerable number of patients may live beyond this period, and an age of eight to ten years or even more is quite compatible with the presence of this anomaly.

Taussig (14, 15) places great emphasis upon the fluoroscopic study of the heart in the diagnosis of this condition. The shadow of the great vessels is described as being narrow in the anteroposterior projection, the usual convex contour of the pulmonary artery on the left side of the heart being absent. In the left oblique view, the vascular pedicle is increased in width, due to the posterior position of the pulmonary artery in relation to the aorta. In addition, the heart is almost always enlarged. The enlargement is typically progressive, with involvement of both ventricles but with the right predominating. Also frequently (unless there is a pulmonic stenosis) the vascular structures in the lung are increased in prominence, and occasionally hilar pulsations are visible at fluoroscopy.

Progress in the surgical therapy of transposition of the great vessels has given impetus to the use of special diagnostic procedures. Whereas the diagnosis can be made from clinical and conventional radiographic studies (14, 15) in a moderately high percentage of cases, very little can be determined concerning the location or size of intracardiac or extracardiac shunts by these methods. Since present surgical treatment depends in part upon the establishment of an adequate interatrial septal defect (3), it is important to determine preoperatively if such a defect is present. Furthermore, there is a sizable group of cases in which for some reason the heart either does not enlarge significantly or does not assume the contour usually seen in transposition of the great vessels. The diagnosis in these cases is difficult, and special procedures are indicated.

Once the diagnosis has been established, other observations may be of value in determining the location of intracardiac shunts. A rhythmic change in the size of the right atrium (Taussig), independent of respiratory phase, is evidence of a reversible shunt through a patent foramen ovale. Furthermore, cardiac catheterization, which is of little assistance in establishing the presence of a complete transposition, may become quite informative in determining the location of intracardiac shunts once the diagnosis has been made (4).

Angiocardiography has been used extensively in the diagnosis of congenital anomalies of the heart and great vessels by Castellanos, (5) Sussman, Grishman and Steinberg (13), and others. Castellanos has presented the angiocardiograms of several cases of complete transposition of the great vessels and has discussed the significance of his findings. It appears, however, that the contributions of this special procedure toward an understanding of the condition would be further clarified by a correlation of the angiocardiographic and autopsy findings in a series of proved cases.

PROCEDURE AND MATERIAL

The angiocardiographic technic employed has been previously described (6). Quite early in our experience with this procedure we concluded that film exposure speeds slightly in excess of 1 per second were inadequate for recording all of the pathways which contrast substance might

follow in passing through a grossly anomalous heart. It appears that speeds of four to six films per second are desirable and doubtless would make the examination more reliable and informative.

Furthermore, identification of the particular phase of the cardiac cycle at which the films are exposed might provide an explanation for the bizarre contours of the ventricular cavities which are frequently seen. This, of course, can be accomplished by correlating the film exposure periods with a simultaneously exposed electrocardiogram. Even more effective would be an arrangement by which the electrocardiographic impulses initiate the exposures. Films could thus be secured at any previously designated part of the heart cycle.

Since most of the recorded deaths following this procedure have occurred after a second or third injection of the contrast substance, filming in two planes simultaneously would be advantageous. It would thus be possible to obtain a three-dimensional impression of the heart and great vessels without the risks of a second injection. Investigations of equipment designed to meet the requirements just mentioned have been under way for some time (Morgan, 11) and are continuing. The apparatus recently described by Fredzell and his colleagues (8) would seem to represent a distinct advance, approaching the requirements of the ideal apparatus.

More than 350 patients with congenital cyanotic heart disease have been subjected to angiocardiography at The Johns Hopkins Hospital during the past four years.[3] Of this group, 52 patients were thought to have a complete transposition of the great vessels. Thirteen of these came to autopsy and the diagnosis was confirmed. These 13 autopsied cases form the basis of the present report. The remaining 39 patients, in addition to angiocardiography, underwent routine studies and in many instances had right heart catheterization. More than half of this group have been operated upon, and all of the findings tended to support the diagnosis of complete transposition. The angiocardiographic findings in the 39 patients who have survived were similar in most details to those found in the 13 cases here presented. Consequently, it was felt that very little was to be gained from a detailed study of this larger group. Furthermore, it must be emphasized that combined studies including the rather limited inspection permitted at operation may not reveal the true internal structure of the heart and that only a careful autopsy examination can be considered as reliable.

For convenience and clarity in presentation, the 13 autopsied cases have been classified according to the defect or defects which were associated with the transposition. Differentiation of these accompanying defects by angiocardiography was frequently impossible; however, presentation of the observations and material is made easier by using such a classification.

I. COMPLETE TRANSPOSITION OF THE GREAT VESSELS WITH INTERATRIAL SEPTAL DEFECT

(Two Cases)

CASE 1: J. D. M., a white male infant of 11 months, had been cyanotic since birth, was a feeding problem, and had developed poorly.

Physical examination showed moderate clubbing of the extremities and cyanosis. The heart was enlarged and there was a systolic murmur with maximum intensity in the second left interspace.

Fluoroscopy and conventional roentgenography (Fig. 2A) showed that the heart was enlarged and rotated with the apex toward the right side. The base of the heart was narrow and the hilar shadows were increased in prominence and pulsated.

The electrocardiogram was compatible with the presence of a rotational dextrocardia. The red blood count was 8.75 million and the peripheral oxygen arterial saturation was 45 per cent. The clinical impression was "transposition of the great vessels with a posteriorly placed pulmonary artery."

The patient was referred for angiocardiography in order to determine if there was a large interauricular septal defect and also to determine the location of the right auricle in a rotated heart.

Angiocardiography: Contrast material entered

[3] We wish to acknowledge with thanks the technical assistance of Miss Marjorie May, whose help was of great value in performing these examinations.

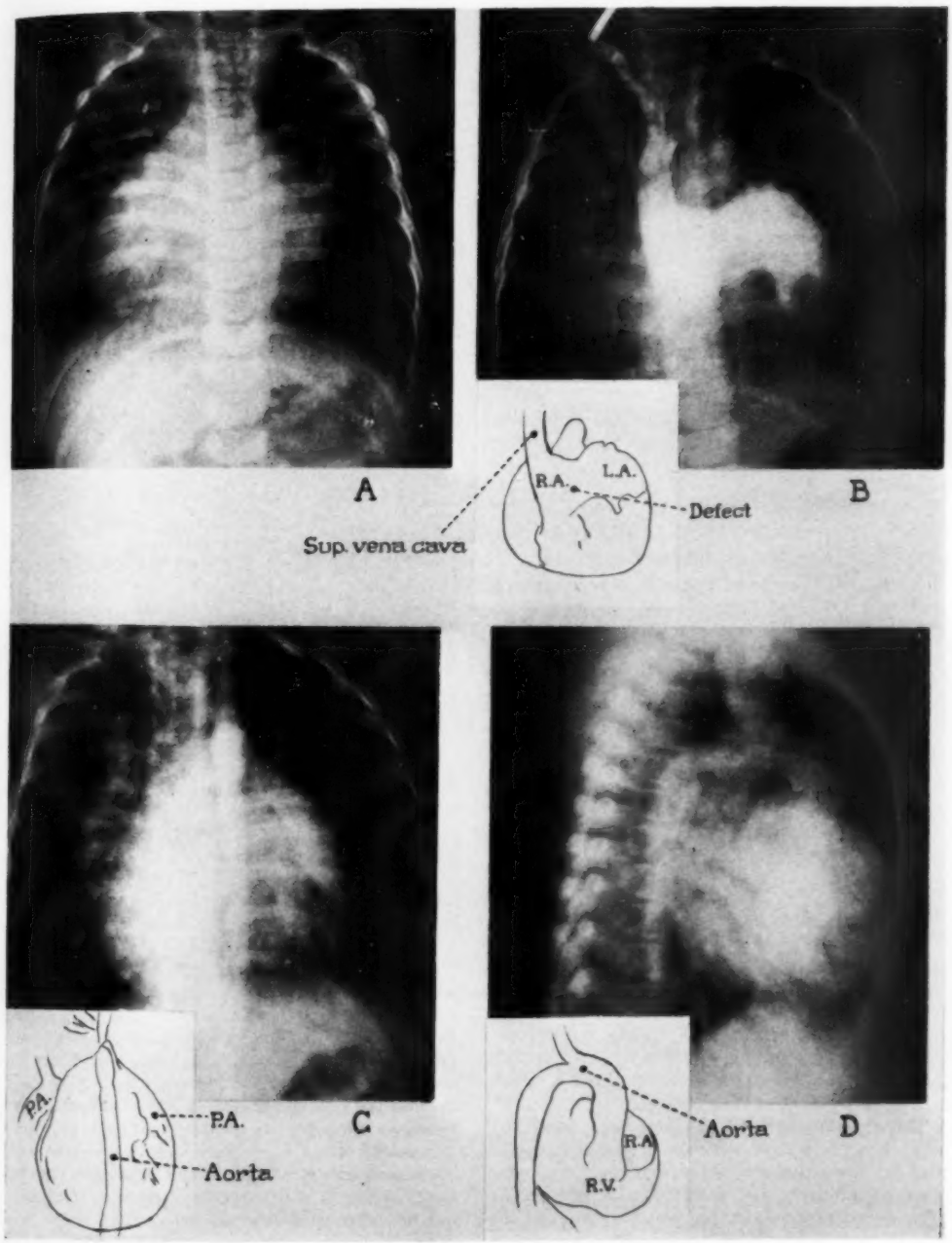

Fig. 2. Case 1, Group I. Complete transposition of the great vessels with large interatrial septal defect and partial rotation of the heart. For further description see text

the right auricle through a normally placed right superior vena cava (Fig. 2B). The right auricle was well outlined and communicated with the left auricle through a large defect. One second later (Fig. 2C) the aorta contained a high concentration of the contrast medium and there was a moderate

concentration in the pulmonary arteries bilaterally. The aorta originated to the right of the midline and arched slightly toward the left and posteriorly. Figure 2D (lateral projection two seconds after the end of the injection) shows that the aorta had again filled with a high concentration of the contrast substance. It was of normal size and originated rather far anteriorly, but not so far as in some of the other cases presented in this series. The main pulmonary artery could not be identified.

The impression given by the angiocardiographic findings was (*a*) complete transposition of the great vessels, (*b*) large interatrial septal defect, and (*c*) partial dextrorotation of the heart.

Since a large interatrial septal defect was present, it was felt that surgery would be of little benefit. Accordingly the patient was sent home, where he died four months later.

Autopsy performed elsewhere confirmed the diagnosis of transposition of the great vessels with a large interatrial septal defect.

Comment: A suspected diagnosis of transposition of the great vessels was confirmed, although the findings were not as definite as in some of the other cases which will be shown below. In addition, a large interatrial septal defect was demonstrated. It was felt that dextrorotation of the heart may have altered somewhat the relationships of the heart and great vessels, accounting for the position of the ascending aorta in this case. It was not so far anterior in relation to the heart as in the usual case of transposition without dextrorotation.

CASE 2: M. T. M., a white male of 9 months, had been cyanotic since birth, was a feeding problem, and had many upper respiratory infections. The heart was enlarged and the vascular markings in the lungs were increased in prominence.

The clinical impression was "complete transposition of the great vessels." The patient was referred for angiocardiography in order to confirm the clinical diagnosis and to determine if a sizable interatrial septal defect was present.

The *angiocardiographic findings* (not illustrated here) were typical of a complete transposition in that (*a*) the aorta was of average size, originated quite far anteriorly, and filled with a high concentration of contrast substance, and (*b*) the vascular structures in the lung, although large, filled poorly. There was no evidence of a sizable interatrial septal defect. Two injections were made and both were thought to be satisfactory.

At surgery an interatrial septal defect was established, but the patient died four days postoperatively.

Autopsy (Dr. Selby) confirmed the diagnosis of complete transposition. There was a patent foramen ovale which in the fixed specimen admitted a probe 3 mm. in diameter. Since there was no interventricular septal defect or patent ductus arteriosus, the entire exchange of blood between the two sides of the heart must have occurred through the patent foramen ovale.

Comment: Angiocardiography failed to demonstrate a patent foramen ovale 3 mm. in diameter. Usually a defect of this size is not very significant physiologically; in this instance, however, it provided the sole means of exchange of blood between the two sides of the heart.

II. COMPLETE TRANSPOSITION OF THE GREAT VESSELS WITH INTERVENTRICULAR SEPTAL DEFECT

(Two Cases)

CASE 1: M. S., a white female child of 6-1/2 years, had been cyanotic since birth. Her activities were quite limited and she was short of breath.

Physical examination showed that she was underdeveloped, with well marked cyanosis and clubbing of the fingers and toes. There was a fairly loud systolic murmur, heard best just to the left of the sternum in the third intercostal space.

Conventional radiography (Fig. 3A) showed moderate enlargement of the heart and an increased prominence of the vascular structure in the lungs.

The clinical impression was "possible" partial or complete transposition of the great vessels. Angiocardiography was sought in order to confirm the clinical impression and also to determine if a sizable interatrial septal defect was present.

Angiocardiography (Fig. 3B, C, and D): Contrast material entered the right auricle through a large right superior vena cava and was immediately expelled through the aorta in high concentration. The aorta was normal in size but originated quite far anteriorly (Fig. 3D). In Figure 3C it can be seen that some of the contrast substance apparently entered the left ventricle. It was assumed that it found its way into the ventricle through an interventricular defect, since there was no evidence of an interatrial defect. Some of the substance entered the branches of the pulmonary artery in the lungs, but the main trunk was not seen. The impression given by angiocardiography was that there was a transposition of the great vessels with an interventricular septal defect.

At surgery a large interatrial defect was established, but the patient died three hours following the procedure.

Autopsy (Dr. Selby) confirmed the diagnosis.

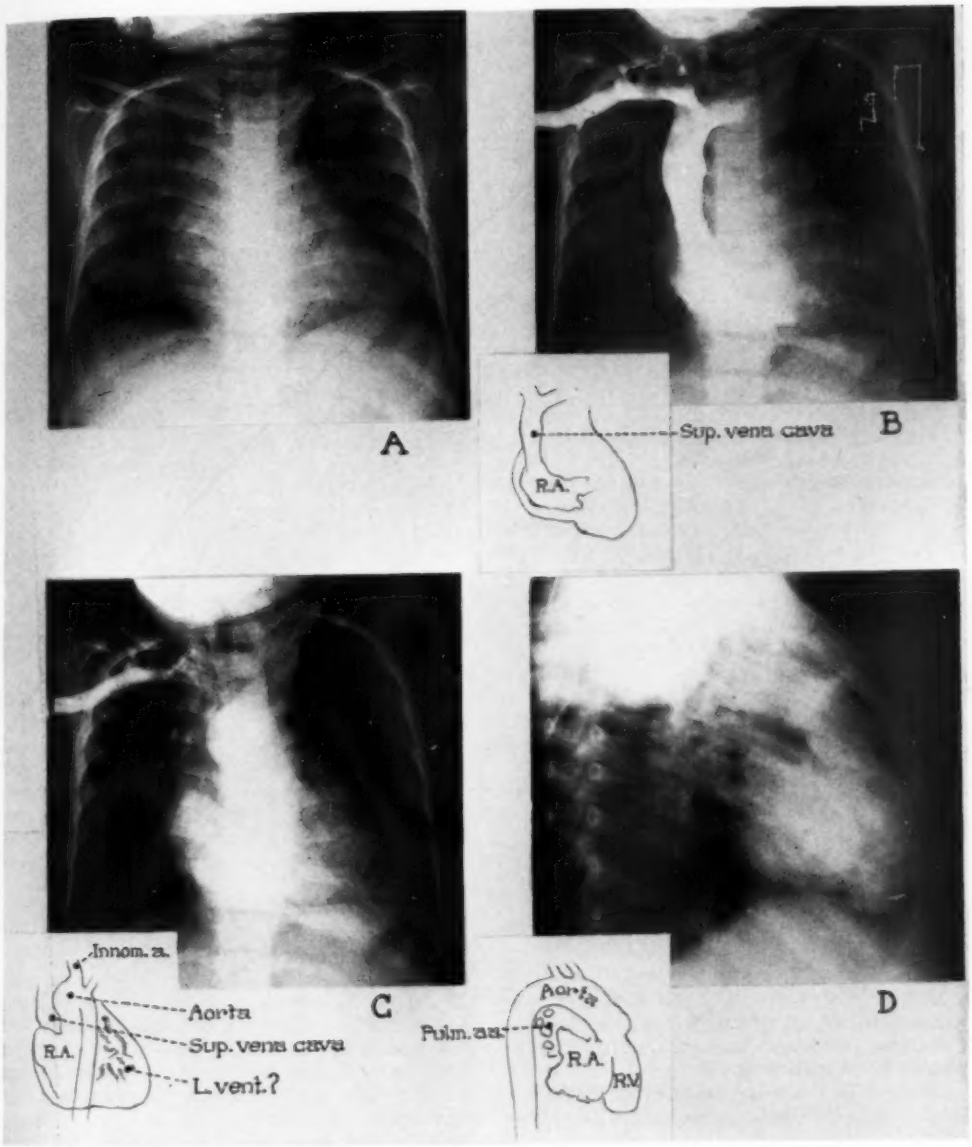

Fig. 3. Case 1, Group II. Complete transposition of the great vessels with interventricular septal defect (5 × 10 mm.). For further description see text.

There was a high interventricular septal defect measuring 5 × 10 mm.

Comment: The presence of an interventricular defect can usually be inferred if contrast substance enters the left ventricle and there is no direct evidence of an interatrial defect. A moderate-sized interventricular defect may be associated with a considerable life span—*e.g.*, six and a half years.

CASE 2: J. R. H., a white male child of 32 months, was one of twins; the other twin was entirely normal. Cyanosis was noted during the first weeks of life and had been persistent. Develop-

ment had been delayed, and the patient had attacks during which he apparently lost consciousness.

Physical examination showed minimal clubbing of the fingers and toes, but well marked cyanosis. Development was poor. There was a loud rasping systolic murmur, best heard along the left sternal border.

Conventional radiography indicated that the heart was moderately enlarged. The left upper border was straight, and in the right anterior oblique position there was a concavity in the region usually occupied by the pulmonary artery. There was increased prominence bilaterally of the hilar vascular markings, but they did not pulsate. Both ventricles were thought to be enlarged.

The clinical impression was "transposition of the great vessels."

Angiocardiography (Fig. 4A, B, C, and D): Contrast substance entered the right auricle through a normally placed right superior vena cava. Within two seconds (Fig. 4B and D) it was expelled through the aorta in high concentration. In the lateral view it can be seen that the aorta originated far anteriorly and apparently entirely from the right ventricle. In the anteroposterior projection the contrast material had extended toward the left border of the heart (Fig. 4B). Presumably it was still in the right ventricle. A faint concentration of the opaque substance could be identified in the pulmonary arteries. There was no evidence of an interatrial septal defect. In the lateral view there was a faint shadow posterior to the aorta, which may have represented the pulmonary artery.

The impression gained from the angiocardiographic findings was "transposition of the great vessels with the pulmonary artery filling through a patent ductus or interventricular defect."

Surgical treatment consisted of the establishment of a large interatrial septal defect. In addition, the proximal portion of the right subclavian artery was anastomosed to the distal portion of the branch of the pulmonary artery going to the right upper lobe. The patient tolerated the operative procedure well, but on the fourth postoperative day signs of cerebral thrombosis appeared, respirations became poor, and death ensued.

Autopsy (Dr. Eversole) confirmed the diagnosis of complete transposition. There was a high interventricular defect nearly 1 cm. in diameter. The foramen ovale was anatomically closed, but there was a large surgically created interatrial defect. The ductus was closed. In the left ventricle there was an anomaly of the chordae tendinae, which took their origin from the margins of the ventricular defect instead of the papillary muscles. This apparently produced a mild subvalvular pulmonic stenosis. The pulmonary artery, however, was approximately as large as the aorta.

Comment: Although the presence of an interventricular defect might have been inferred, there was very little evidence of such a defect. The markedly anterior position of the aorta was clearly shown.

III. COMPLETE TRANSPOSITION OF THE GREAT VESSELS WITH A PATENT FORAMEN OVALE AND AN INTERVENTRICULAR SEPTAL DEFECT

(Three Cases)

In 2 of the cases coming under this heading the patent foramen ovale was not large enough to be of physiological significance. Consequently the angiocardiographic findings were quite similar to those in the preceding group.

CASE 1: J. B. was a white male of 7 years. Cyanosis was first noticed during the second week of life. For a time it had been progressive but then seemed to improve, and the patient developed moderately well. He was able to walk five or six blocks.

Physical examination showed the patient to be well nourished and well developed. There was marked cyanosis with clubbing of the fingers and toes. The blood pressure was so low that it was unobtainable.

Conventional radiography (Fig. 5A) showed slight cardiac enlargement. The base of the heart was narrow, but otherwise the contour was not distinctly abnormal. The hilar shadows and vascular markings in the lungs were prominent.

The clinical impression was "possible transposition of the great vessels."

Angiocardiography (Fig. 5B and C): Contrast material entered the right auricle through a normally placed right superior vena cava and was immediately expelled through the aorta in high concentration. The aorta was normal in size and originated quite far anteriorly. There was faint opacification of the left auricle in the lateral view and also of the branches of the pulmonary artery. In an ensuing series of films, not shown here, the aorta began to lose density at about four seconds, regaining it at about six to seven seconds. This was taken as evidence of recirculation due to shunting of blood from the left side of the heart.

The impression gained from the angiocardiographic findings was transposition of the great vessels with an interatrial septal defect. This defect was thought to be small, but more contrast substance entered the pulmonary arteries than could be accounted for by a small defect.

Surgical treatment consisted of a double anastomosis; the proximal portion of the right pulmonary artery was anastomosed to the superior vena cava, and the proximal portion of the right

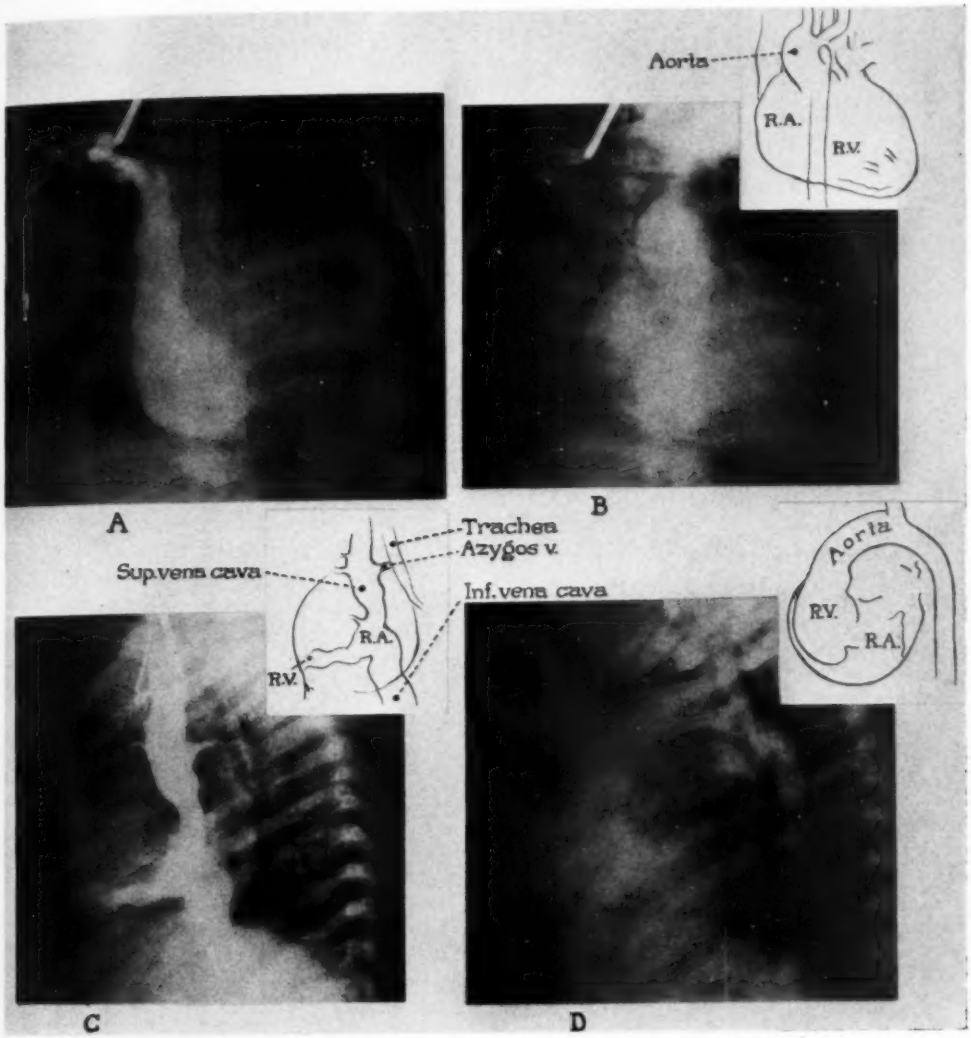

Fig. 4. Case 2, Group II. Complete transposition of the great vessels with a 1-cm. interventricular septal defect. For further description see text.

subclavian artery was anastomosed to the distal portion of the pulmonary artery. The patient died four days postoperatively.

Autopsy (Dr. Morse) confirmed the diagnosis of transposition. The foramen ovale was guarded by an incompetent valve, and this permitted an opening about 8 mm. in diameter. In addition, there was a high interventricular defect in the membranous septum measuring 1 cm. in diameter.

Comment: A small interatrial defect was diagnosed and it was estimated that the amount of contrast substance in the lungs was more than could be accounted for by so small a defect. The presence of either an interventricular defect or a patent ductus might have been inferred. This is the only case in this series in which reopacification of the aorta was demonstrated. It indicates that a considerable amount of aerated blood in the left side of the heart reached the systemic circulation. Such a condition is in keeping with the increased life span of the patient.

CASE 2: S. G., white male infant, aged 10 months, had been cyanotic since birth and had

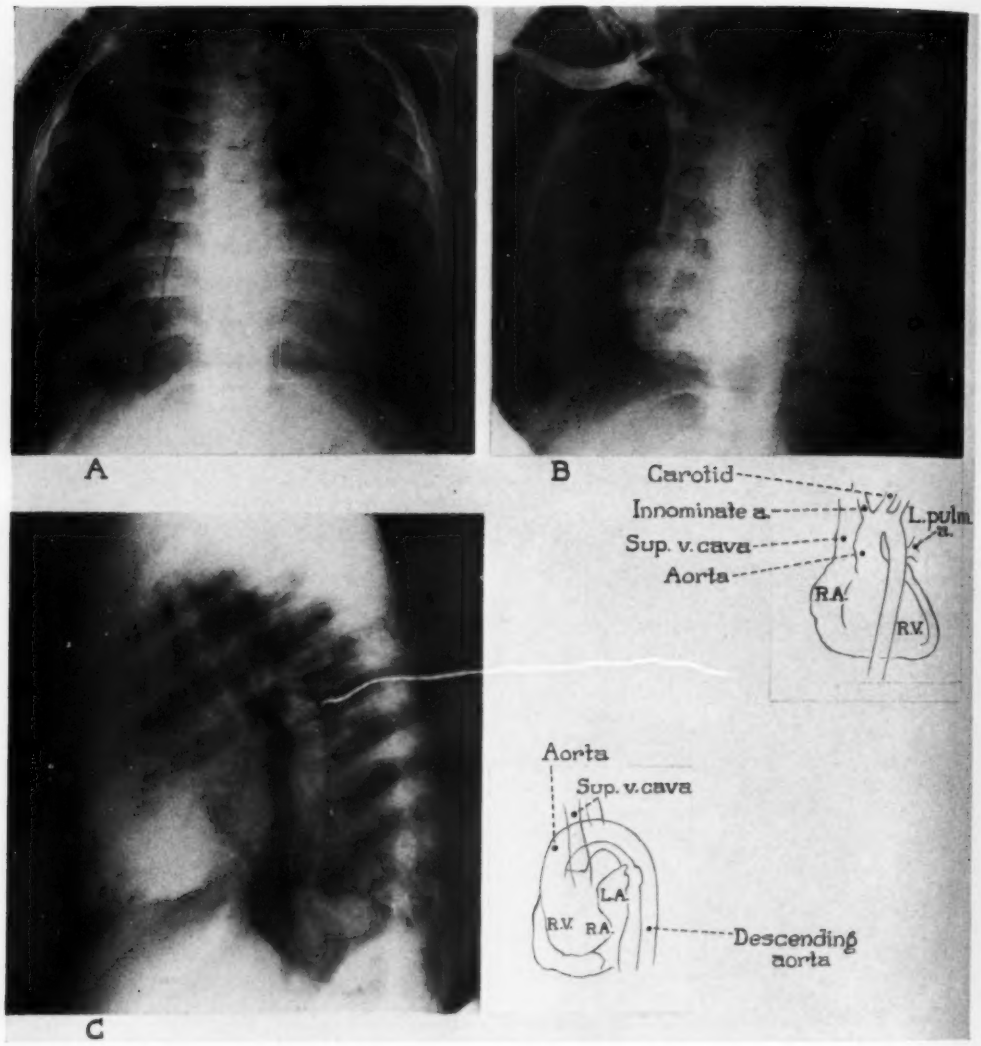

Fig. 5. Case 1, Group III. Complete transposition of the great vessels with patent foramen ovale (8 mm.) and interventricular septal defect (1 cm.). For further description see text.

been kept for the greater part of his life in an oxygen tent. Development consequently was markedly retarded.

Physical examination showed clubbing of the fingers and toes and severe cyanosis. The heart was thought to be enlarged, and there was a murmur best heard to the left of the sternum.

Conventional radiography (Fig. 6A) showed a moderately enlarged heart and quite prominent vascular markings in the lungs. On fluoroscopy, the pulmonary vessels pulsated minimally. This was best observed in the region of the right hilus. The base of the heart was somewhat narrow.

The clinical impression was "transposition of the great vessels with possibly an interatrial septal defect."

Angiocardiography (Fig. 6B and C): Contrast material entered the right auricle through a normally placed right superior vena cava and was immediately expelled through the aorta in high concentration. The aorta originated quite far anteriorly, arched almost directly backward, and was approximately normal in size. Two small vessels seen near the origin of the aorta in the anteroposterior view may represent coronary arteries. The left auricle did not distinctly opacify and there was thus no evidence of

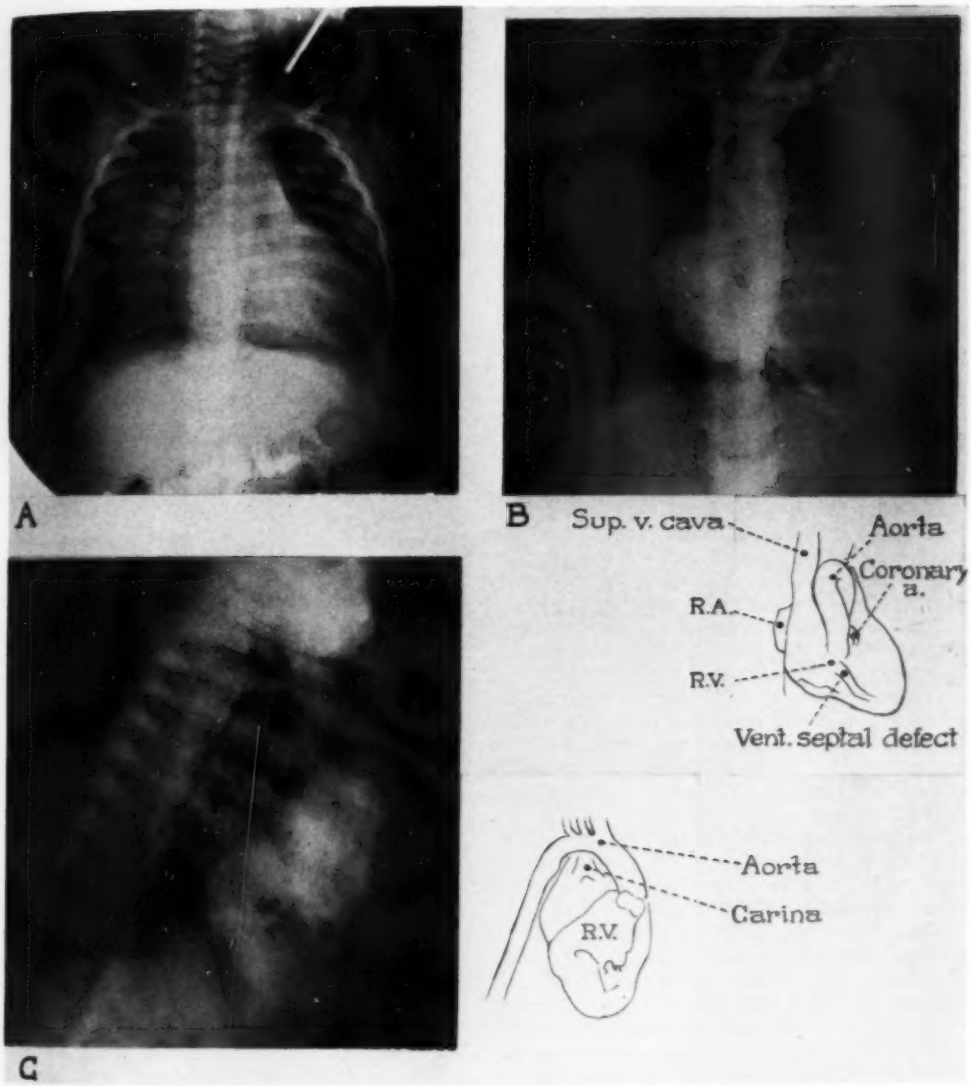

Fig. 6. Case 2, Group III. Complete transposition of the great vessels with a small patent foramen ovale and an interventricular septal defect (5 mm.). For further description see text.

an interatrial defect. There was, however, a streak-like area of opacity in the region of the left ventricle which could represent contrast substance entering the left ventricle through an interventricular defect. A slight increase in the opacity of the pulmonary vessels was observed but is not well shown on the reproduction.

The impression obtained from the angiocardiographic findings was transposition of the great vessels with an interventricular septal defect.

The patient underwent a double anastomotic procedure such as was described for Case 1 in this group (proximal pulmonary artery to superior vena cava and proximal subclavian artery to the distal pulmonary artery). Death occurred about five hours postoperatively.

Autopsy (Dr. Hopkins) confirmed the diagnosis of transposition. In addition, there was an anatomically patent foramen ovale which admitted a probe about 3 mm. in diameter and an interventricular defect about 5 mm. in diameter. The pulmonary artery was larger than the aorta.

Comment: One can speculate on whether or not the streaked area of density extending toward the left side of the heart represents the entrance of contrast substance into the left ventricle through a defect. It is difficult to explain this finding on any other basis. However, it is likely that the difference in pressure between the two ventricles was so small that it is improbable that the contrast substance would assume such a contour upon entering the left ventricle.

The heart was relatively larger than that in Case 1 and the degree of disability somewhat greater. The interatrial and interventricular defects were considerably smaller.

CASE 3: M. G., white female aged 6 years, had been cyanotic since six weeks of age. She was moderately well developed and exercise tolerance was relatively good; *i.e.*, she could walk five or six blocks without stopping.

Physical examination showed marked clubbing of the extremities and cyanosis. The heart was not definitely enlarged and there were no murmurs.

Conventional radiography (Fig. 7A) confirmed the impression that the heart was not definitely enlarged. There was a concavity in the region of the pulmonary artery and the lung markings were increased in prominence. This was most noticeable in the right lung.

The impression obtained from these conventional studies was that no definite diagnosis could be made, but there were no indications for the surgical establishment of an artificial ductus arteriosus.

Angiocardiography (Fig. 7B and C): Contrast material entered the right auricle through a normally placed right superior vena cava and was immediately expelled through a moderate-sized aorta, in high concentration. The aorta lay near the midline, originated far anteriorly, and arched almost directly posteriorly. Streaks of contrast substance extended far toward the left heart border; presumably they were in the left ventricle. The branches of the pulmonary arteries in the lungs filled with a minimal concentration of the opaque medium and appeared to be of moderate size.

The findings were regarded as inconclusive, but a tetralogy of Fallot was thought to be the most likely possibility. Our experience at that time was limited. In retrospect, it is seen that this case resembles the cases which have just been described.

The patient was explored with the hope that an operative procedure might be of benefit. The pulmonary artery lay behind the aorta, was equally as large as the aorta, and had a pressure in excess of 900 mm. of saline. Since the diagnosis was uncertain, nothing more was done and the chest was closed. Death occurred on the fourth postoperative day, from what appeared to be cerebral anoxemia.

Autopsy (Dr. Burnett) showed a complete transposition of the great vessels with an associated high interventricular septal defect which measured 1 cm. in diameter. The foramen ovale was anatomically patent, although the opening was only a small slit not over 2 to 3 mm. in diameter. The pulmonary arteries were dilated and showed numerous areas of arteriosclerosis.

Comment: This case resembles Case 1 in this group in many respects. The patient had a longer life span than usual and a small patent ovale. The heart was not definitely enlarged. The vascular markings were not as prominent as in Case 1, however, and the differentiation from a tetralogy of Fallot was more difficult. In retrospect, it can be seen that the aorta was farther anterior than in the tetralogy of Fallot. The pulmonary vascular markings were prominent, yet they contained very little of the contrast material; this is in contrast to what is usually seen in a tetralogy.

IV. COMPLETE TRANSPOSITION OF THE GREAT VESSELS WITH A PATENT DUCTUS ARTERIOSUS AND AN INTERVENTRICULAR SEPTAL DEFECT

(Two Cases)

CASE 1: C. K., white female of 4 months, was apparently normal until the age of five weeks, when the mother noted that the baby was pale. At six weeks there was definite cyanosis, and this was soon followed by dyspnea. There were attacks of cyanosis accompanied by apparent loss of consciousness.

The patient was moderately well developed with severe cyanosis but without clubbing of the extremities. The heart did not appear to be enlarged and there was a questionable soft systolic murmur at the apex.

Fluoroscopy and conventional radiography indicated slight enlargement of the heart, with a narrow base and a slight concavity in the region of the pulmonary artery. There were increased vascularity of the lungs and definite hilar pulsations.

An electrocardiogram showed a right axis deviation with right ventricular hypertrophy.

The clinical impression was "probable transposition of the great vessels."

Angiocardiography (Fig. 8A, B, C, and D): Contrast material entered the right heart through

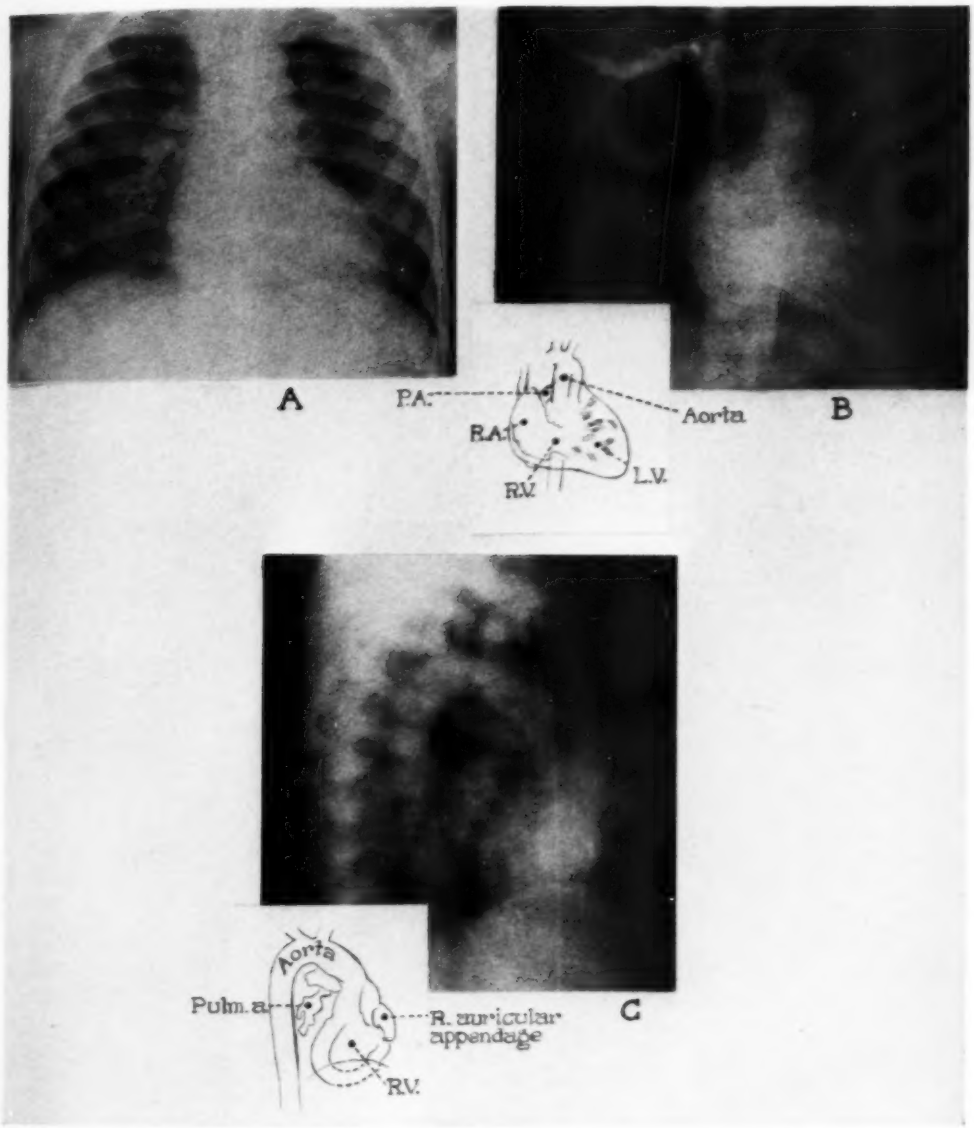

Fig. 7. Case 3, Group III. Complete transposition of the great vessels with a small patent foramen ovale and an interventricular septal defect (1 cm.). For further description see text.

both a right- and left-sided vena cava and was immediately expelled through a normal-sized aorta. The ascending portion was far anterior and somewhat to the right of the midline. With the patient rotated somewhat to the right the aorta appeared to originate entirely from the right ventricle. No contrast substance was evident in the proximal pulmonary artery. However, its more distal branches filled promptly but with less concentration than the aorta. The left auricle was not identified, and there was no evidence of an interatrial septal defect.

The impression obtained from the angiocardiographic findings was: (*a*) transposition of the great vessels; (*b*) no evidence of an interatrial septal defect; (*c*) double superior vena cavas.

A large interatrial septal defect was established, but the patient did not survive the operative procedure.

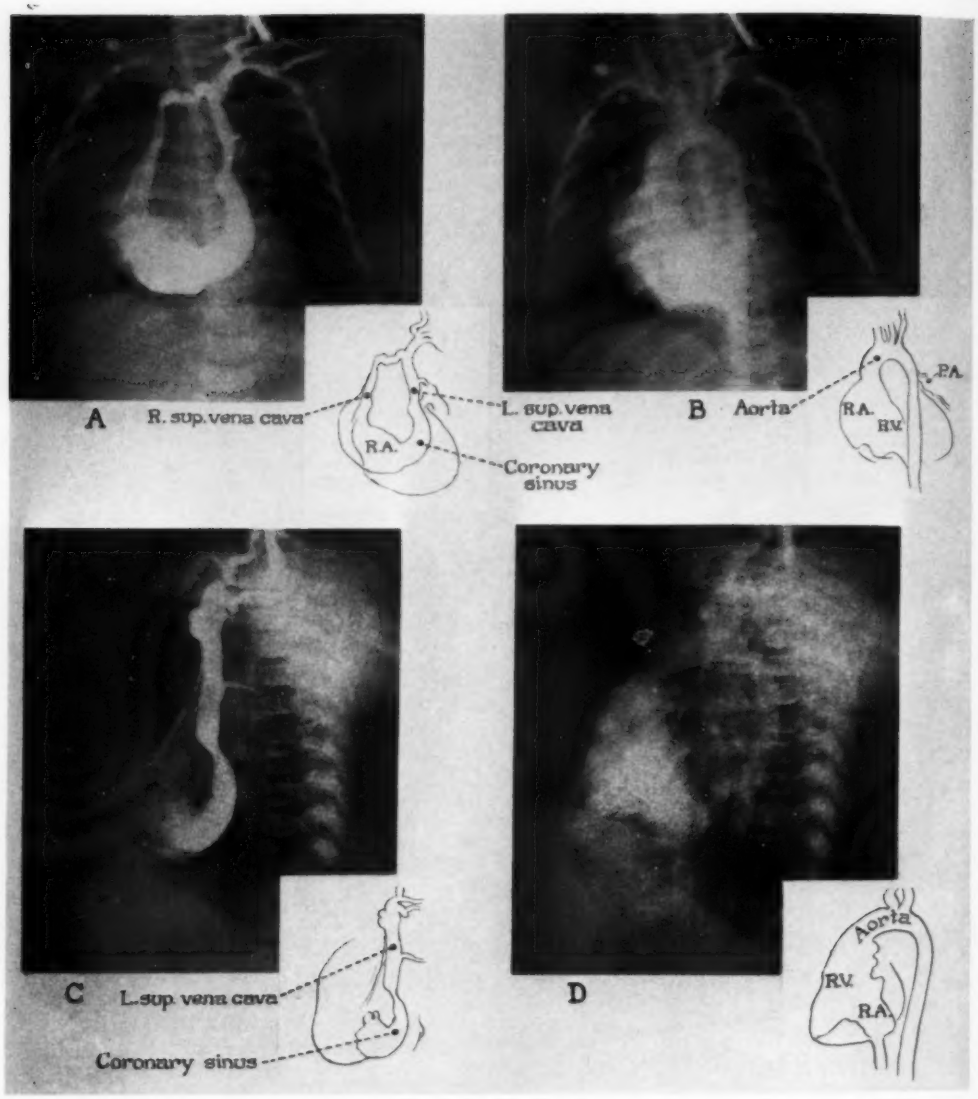

Fig. 8. Case 1, Group IV. Complete transposition of the great vessels with patent ductus arteriosus (4 mm.), interventricular septal defect (8 mm.), and double superior vena cavas. The foramen ovale was anatomically closed. For further description see text.

Autopsy (Dr. Shannon) confirmed the diagnosis of transposition. There was an interventricular septal defect 8 mm. in diameter. The foramen ovale was closed, but there was a patent ductus approximately 4 mm. in diameter. The pulmonary artery was slightly larger than the aorta. The left superior vena cava entered the right auricle through the coronary sinus.

Comment: A sizable patent ductus was not demonstrated. Figure 8B shows the left pulmonary artery to contain opaque material, although the main pulmonary artery was not seen. This suggests that the distal artery filled from an extracardiac source. However, we believe such evidence is not adequate for this diagnosis. There were no definitive signs which allowed differentiation from other cases of transposition of the great vessels.

CASE 2: C. W., white male aged 5 months, had been a feeding problem from the first week of life. Cyanosis was first noticed at two weeks of age. There were attacks of extreme cyanosis associated with rigidity of the extremities.

Examination showed well marked cyanosis but no clubbing. The heart was enlarged and there was a systolic murmur, heard best just to the left of the sternum. A thrill could be felt over the same region.

Conventional radiography showed enlargement of the heart. The base of the heart was slightly narrowed. The vascular markings in the lungs were increased in prominence.

The clinical impression was "transposition of the great vessels."

Angiocardiography: Films are not reproduced here, but the findings were rather typical of a transposition. The aorta originated far anteriorly, was of moderate size, and arched almost directly posteriorly. There was no evidence of an interatrial septal defect. In the region of the left ventricle was a poorly defined shadow, which may have represented filling of the left ventricle through an interventricular defect.

An interatrial defect was surgically established, but the patient died twenty-six hours later with bradycardia and apparently myocardial failure.

Autopsy (Dr. Wolfson) confirmed the diagnosis of transposition with a high ventricular septal defect. The foramen ovale was closed. There was a patent ductus about 2 mm. in diameter.

Comment: Again there was a failure to demonstrate a patent ductus, although it was small and probably of little physiological significance.

V. TRANSPOSITION OF THE GREAT VESSELS WITH PATENT FORAMEN OVALE, PATENT DUCTUS ARTERIOSUS AND AN INTERATRIAL SEPTAL DEFECT

(Two Cases)

This group, again, will be seen to present no distinguishing angiocardiographic features which permit differentiation from other cases of transposition.

CASE 1: L. B., white male aged 5 years, had been cyanotic since birth, though the cyanosis had not been progressive. He had been so protected by his parents that his exercise tolerance was not known.

On physical examination the patient appeared well nourished and well developed. There were dusky cyanosis and marked clubbing of the fingers and toes. The left chest was larger than the right. There were no murmurs, but the second sound was split. The liver was palpable three finger breadths below the costal margin.

Fluoroscopy and conventional roentgenography (Fig. 9A) showed a moderately enlarged heart with a straight left upper border. The vascular markings in the lungs were increased in prominence and the vessels in the right hilus pulsated.

The electrocardiogram showed a right axis deviation, but unipolar leads suggested some left ventricular hypertrophy.

The impression obtained from the above studies was that "a transposition of the great vessels was likely, although an Eisenmenger's complex could not be excluded."

Angiocardiography (Fig. 9B and C): Contrast substance immediately filled the right auricle and right ventricle, and the aorta filled at the end of two seconds. Again the aorta originated quite far anteriorly (Fig. 9C), filled with a high concentration of opaque material, and was of average size. The heart was rotated somewhat to the left and it was thus difficult to determine if the contrast material entered the left ventricle. There was very slight filling of the distal pulmonary arteries but the main pulmonary artery was not visualized.

The impression obtained from the angiocardiographic findings was: (*a*) transposition of the great vessels with an interventricular septal defect; (*b*) no definite evidence of a sizable interatrial septal defect.

At surgery the right upper lobe branch of the pulmonary artery was divided and ligated. At this point the right pulmonary artery was anastomosed, side to side, to the superior vena cava. The pulmonary artery was a large thick-walled structure. Shortly after the patient's chest was closed the heart stopped beating.

Autopsy (Dr. Bowers) showed a complete transposition of the great vessels with a high interventricular septal defect in the membranous septum which measured 1.2 × 1 cm. The foramen ovale was anatomically patent and would admit a probe 8 mm. in diameter. There was a patent ductus 4 mm. in diameter, and the pulmonary artery was slightly larger than the aorta.

Comment: The patent ductus, 4 mm. in diameter, was not demonstrated in this case. Nor was a patent foramen ovale measuring 8 mm. diagnosed. A valve over the foramen might have been more competent during life than appeared at autopsy. An interventricular septal defect was suspected, since no other means of communication between the two sides of the heart was indicated.

CASE 2: M. B., white female 16 months of age, had cyanosis, becoming progressively more severe,

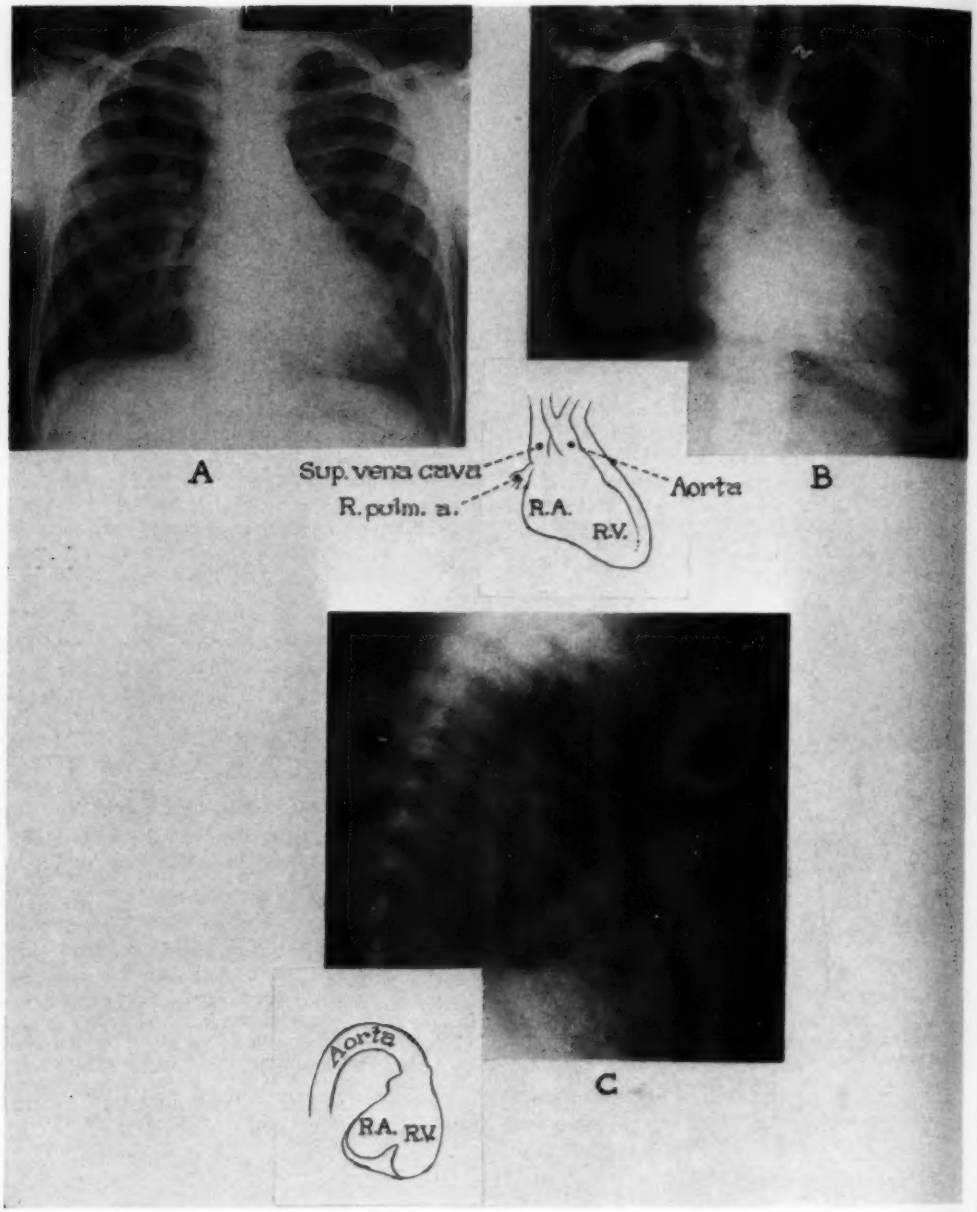

Fig. 9. Case 1, Group V. Complete transposition of the great vessels with an interventricular septal defect (1 × 1.2 cm.), a patent foramen ovale (8 mm.), and a patent ductus arteriosus (4 mm.). For further description see text.

from birth. A partial paralysis of the right arm and leg appeared at six months of age, and development was somewhat delayed.

Examination revealed clubbing of the extremities and cyanosis, a harsh systolic murmur, heard best just to the left of the sternum in the fourth interspace, and a partial paralysis of the right arm and the right leg.

Conventional radiography and fluoroscopy showed the heart to be enlarged and rotated somewhat toward the left. There was increased vascularity of the lungs, and the hilar shadows pulsated.

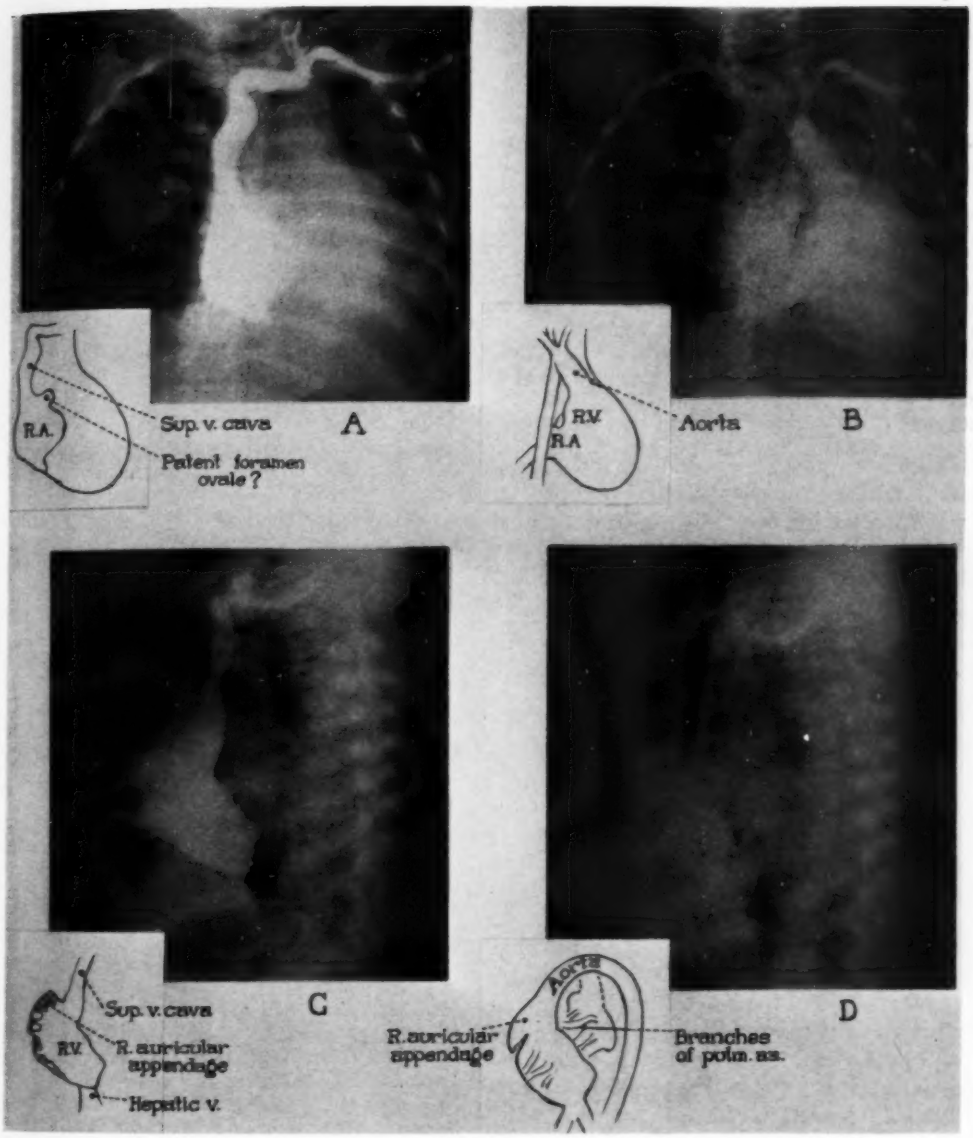

Fig. 10. Case 2, Group V. Complete transposition of the great vessels with two interventricular septal defects each 8 mm. in diameter. In addition, there were a patent foramen ovale (3 mm.) and a patent ductus arteriosus (2.5 mm.). For further description see text.

The clinical impression was "probable transposition of the great vessels."

Angiocardiography (Fig. 10A, B, C, and D): The opaque medium entered the right auricle (Fig. 10A) through a normally placed right superior vena cava. A small amount extended slightly upward and to the left, suggesting that it may have been entering the left auricle through a defect. In the lateral view, however, there was no evidence of filling of the left auricle (Fig. 9C). As usual, the aorta filled with a high concentration of the contrast material, originated far anteriorly, was average in size, and arched toward the right. The pulmonary arteries contained a small but definite amount of the contrast substance. A patent ductus was not demonstrated or suspected.

The impression obtained from angiocardiography was: (*a*) transposition of the great vessels with probable interventricular septal defect; (*b*) questionable evidence of an interatrial septal defect.

A sizable interatrial defect was surgically established, but the patient survived the operation only a few hours.

Autopsy (Dr. Burnett) confirmed the diagnosis of transposition. There were two interventricular septal defects. The posterior defect was 8 mm. in diameter and opened into the right ventricle behind the posterior leaflet of the tricuspid valve. The anterior defect was likewise about 8 mm. in diameter and opened into the right ventricle just below the origin of the pulmonary artery. The foramen ovale was covered with a membrane which would admit a probe about 3 mm. in diameter. There was also a patent ductus arteriosus 2.5 mm. in diameter.

Comment: Again there were no angiocardiographic findings that would permit a differentiation of this case from many other cases of transposition. A small patent ductus was not identified or suspected. A small and relatively insignificant interatrial defect was suspected.

VI. COMPLETE TRANSPOSITION OF THE GREAT VESSELS ASSOCIATED WITH PULMONIC STENOSIS OR ATRESIA

(*Two Cases*)

In one of the next two cases to be presented there were interatrial and interventricular septal defects; in the other only an interatrial defect was present. Striking findings in both cases were a pulmonic stenosis and a partial rotation of the heart. Partial rotation of the heart appears to be fairly common in transposition of the great vessels (3 in 13 cases in this series). Whether it has any association with pulmonic stenosis in this condition is a matter for speculation.

CASE 1: H. J., a 6-year-old white boy, had been cyanotic since birth. Although he gained weight, he remained dyspneic. Exercise tolerance was limited but was better than that of many patients with congenital cyanotic heart disease. Also, as the patient grew older, there was apparently some improvement in the cyanosis and dyspnea.

Physical examination showed moderate cyanosis with clubbing of the extremities. A harsh systolic murmur was audible over the anterior and posterior chest and a systolic thrill could be felt along the left sternal border.

Conventional radiography (Fig. 11A) and fluoroscopy indicated that the heart was not enlarged. The apex, however, was rotated so that it pointed toward the right side, and there was considerable distortion of the heart contour. The vascularity of the lungs was diminished. A rounded convex opacity in the left upper mediastinum pulsated and was thought to represent the aorta, although its exact nature was undetermined.

Electrocardiographic studies using unipolar leads indicated that the apex of the heart was rotated toward the right side.

The impression given from the above findings was: (*a*) tetralogy of Fallot; (*b*) dextrorotation of the heart; (*c*) probably some additional anomaly.

Angiocardiography (Fig. 11B, C, and D): Contrast substance entered the right auricle (Fig. 11B) through a normally placed right superior vena cava and immediately passed into the region of the left auricle. The right auricle was nearer the midline than that usually seen. One second later (Fig. 11C) the aorta had filled with a high concentration of the opaque medium. It arched toward the right but descended near the midline. In addition, it originated quite far anteriorly. There was no evidence of filling of the pulmonary arteries, and the lungs remained translucent throughout the examination.

The impression obtained from angiocardiography was: (*a*) pulmonic stenosis; (*b*) marked overriding of the aorta; (*c*) rotation of the heart. The evidence for the presence of an interatrial septal defect was not recognized at the time of the examination. It was thought that the findings indicated some variant of the tetralogy of Fallot.

The patient was operated upon with the intention of establishing an artificial ductus arteriosus. The chest was opened and dissection was being carried out around the base of the heart when ventricular fibrillation developed. Death occurred a few minutes later.

Autopsy (Dr. MacMurray) revealed a complete transposition of the great vessels, with a patent foramen ovale which admitted a probe 1 cm. in diameter. In addition, there was an interventricular septal defect which measured 1.5 cm. in diameter. The pulmonary artery originated entirely from the left ventricle and was much smaller than the aorta. The pulmonic valve was bicuspid, one of the cusps being much larger than the other. The large cusp had a raphe through the mid portion, indicating a failure of division. This had produced a rather marked degree of pulmonic stenosis.

Comment: Filling of the left auricle was not recognized at the time of the examination, but in retrospect there is good evidence that it did fill.

Complete transposition can be associated with a small heart. When there is a pulmonic stenosis associated with a

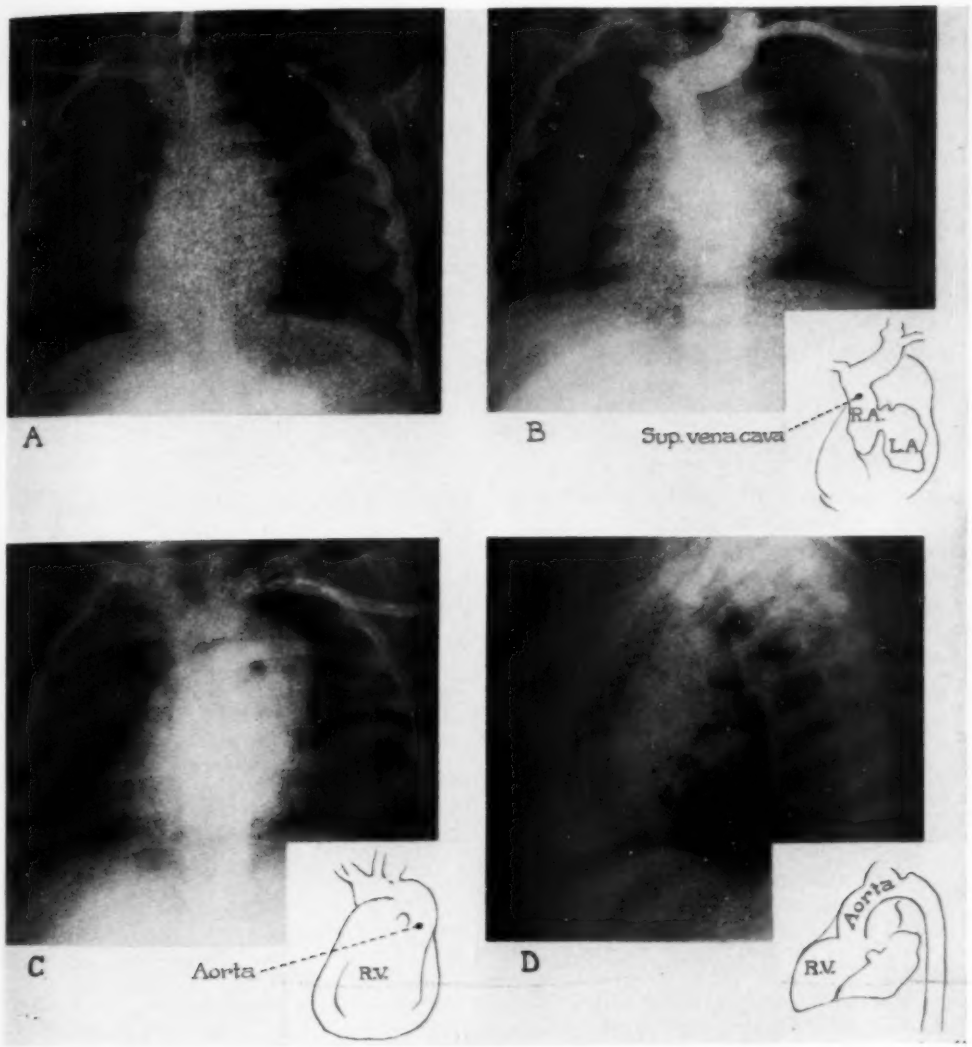

Fig. 11. Case 1, Group VI. Transposition of the great vessels with interatrial (1 cm.) and interventricular (1.5 cm.) septal defects and pulmonic stenosis. In addition, there was a partial dextrorotation of the heart. For further description see text.

small heart, differentiation from the tetralogy of Fallot is difficult. Usually when the aorta originates entirely from the right ventricle it is farther anterior than when it overrides the ventricular septum. Also, typically the pulmonary arteries fill with contrast substance in the tetralogy of Fallot. Only when there is a high degree of stenosis or a pulmonary atresia do they fail to fill. Consequently poor filling or absence of filling of the pulmonary arteries with contrast substance favors a diagnosis of transposition as opposed to a tetralogy. Undoubtedly, however, there are many exceptions to this rule.

CASE 2: T. C. was a white male of 15 months. Cyanosis was first noticed at the age of five days. During the first few months of life there were frequent attacks of dyspnea, during which cyanosis became much more severe. In the few months just

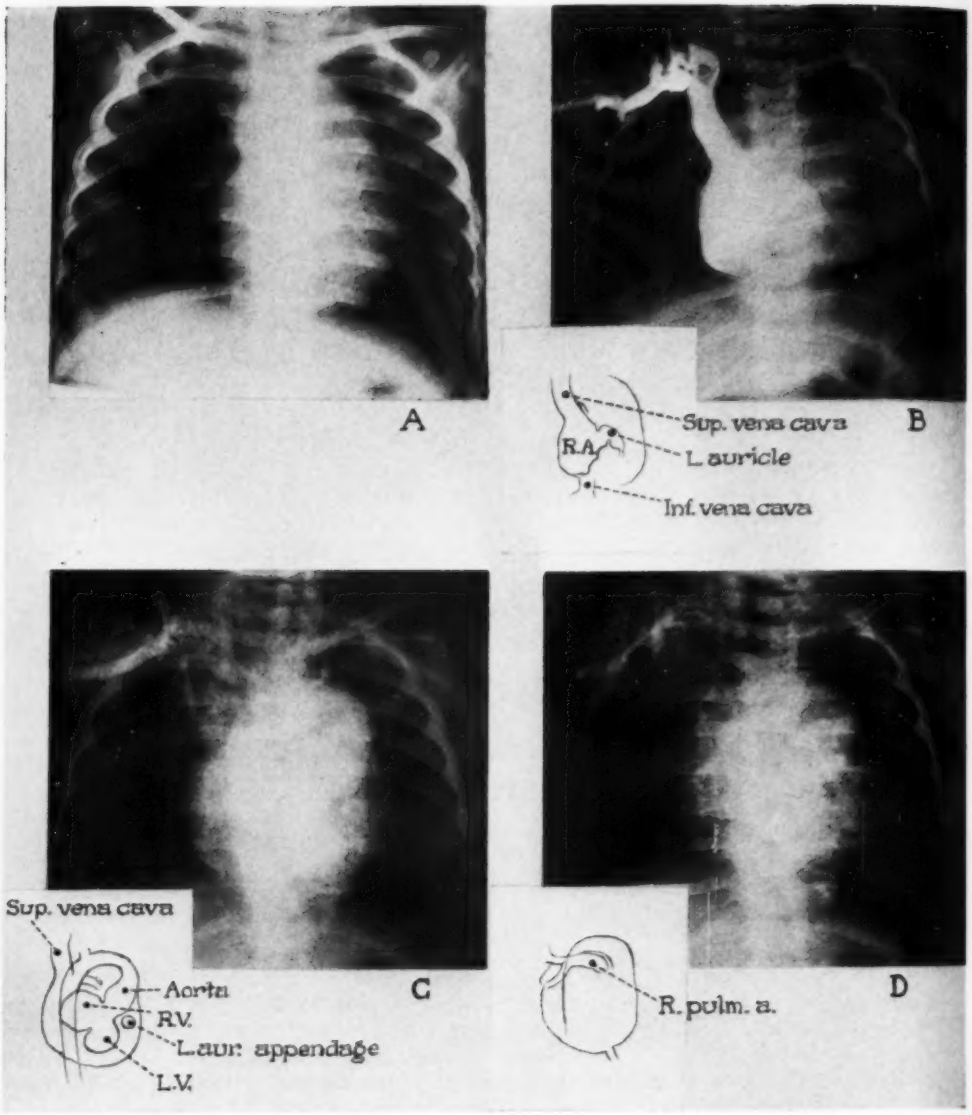

Fig. 12. Case 2, Group VI. Complete transposition of the great vessels with a large (2 cm.) interventricular septal defect, a patent foramen ovale (4 mm.), and a patent ductus arteriosus (4 mm.). In addition there were a pulmonic atresia and a partial dextrorotation of the heart. Note similarity in appearance to Case 1 in this group. For further description see text.

before admission, the number of attacks had decreased and cyanosis was less noticeable. Physical development was somewhat retarded.

Physical examination showed moderate cyanosis and clubbing of the extremities. There was a faint short systolic murmur in the pulmonic region, heard only during inspiration.

Fluoroscopy and conventional radiography (Fig. 12A) indicated that the heart was not enlarged, although its contour was distorted in a manner which was hard to explain. The convexity of the left upper heart border was thought to be due to the aorta. An esophagram indicated, however, that the aorta arched toward the left and its exact course was in doubt. The lungs were radiolucent and the hilar structures were quite small.

The clinical impression was "congenital malformation of the heart, cyanotic group with probable pulmonic stenosis."

Angiocardiography (Fig. 12B, C, and D): Contrast substance entered the right auricle through a normally placed right superior vena cava and immediately some of the substance passed into the region of the left auricle through an interatrial septal defect. One second later a high concentration of the opaque medium filled the aorta. This originated from a queerly shaped ventricular chamber and ascended to the left before arching toward the right and crossing the midline. Unfortunately the lateral views were technically unsatisfactory and the anteroposterior relationship of the aorta to the heart could not be determined. The ventricular cavity from which the aorta filled had an unusual contour and it was difficult to determine whether it represented the right or left ventricle or a single ventricle. A lateral view would probably have been of considerable value in resolving this difficulty.

The pulmonary arteries did not fill immediately, and the lungs remained radiolucent throughout the examination. About four seconds after the beginning of the injection, however, and after the aorta had almost completely emptied the contrast substance, the right pulmonary artery was plainly visible (Fig. 12D) and was opacified. A proximal pulmonary artery was not visible.

The impression obtained from angiocardiography was: (*a*) interatrial septal defect; (*b*) right aortic arch; (*c*) possible single ventricle; (*d*) pulmonic stenosis. The unusual contour of the heart was attributed to some degree of dextrorotation.

Operation was undertaken with the intention of establishing an artificial ductus arteriosus. During the dissection of the left pulmonary artery, hemorrhage developed from a torn patent ductus. The ductus was quickly ligated, but a short time thereafter the heart stopped beating and the patient died.

Autopsy (Dr. Burnett) showed a complete transposition of the aorta, which was somewhat larger than is usually seen in transposition of the great vessels. The right ventricle was dilated and considerably hypertrophied, and a 2-cm. defect was present in the interventricular septum. There was a complete occlusion of the proximal portion of the pulmonary artery, and its exact origin could not be determined. The foramen ovale was partially closed by a valve which gaped and permitted a 4-mm. probe to be inserted from the right into the left auricle. The patent ductus was estimated to have been about 4 mm. in diameter and evidently carried the greater portion of the blood to the lungs. The bronchial arteries were not enlarged.

Comment: The similarity between the present case and Case 1 in this group is evident. One wonders whether there is any real relationship between the dextrorotation of the heart and the pulmonic stenosis or the transposition of the great vessels. It is odd that two hearts with such an unusual group of anomalies should resemble each other so closely.

The interventricular defect was so large that the left ventricle probably filled immediately from the right ventricle. The ventricular cavity demonstrated on the angiocardiogram represents a composite contour of both ventricles. The radiolucency of the lungs associated with failure of the pulmonary arteries to fill constituted good indirect evidence of a pulmonic stenosis. A patent ductus was not suspected or demonstrated. Late filling of the right pulmonary artery might have led one to suspect the occurrence of an extracardiac shunt.

A lateral view would have been of considerable value in locating the position of the ascending aorta and might thus have led to the correct diagnosis of transposition. However, differentiation from the tetralogy of Fallot with such severe pulmonic stenosis is difficult.

The findings in these two cases indicate that pulmonic stenosis when associated with a transposition may improve the efficiency of the heart. At least the heart does not enlarge as it does in other cases of transposition of the great vessels.

DISCUSSION AND CONCLUSIONS

The most reliable angiocardiographic finding in complete transposition of the great vessels is an immediate filling of an anteriorly placed aorta with a high concentration of the contrast substance. This, of course, is best shown by the lateral view, where the ascending aorta is seen frequently to lie just beneath the sternum. Rotation of the heart (Case 1, Group I) may, of course, modify this position somewhat. The aorta is usually more anterior than in the tetralogy of Fallot and is generally not as large unless there is associated pulmonic stenosis (Cases 1 and 2, Group VI).

The proximal pulmonary artery usually fails to fill with a significant amount of the

contrast substance and consequently was not distinctly visualized in any of the angiocardiograms made on the present series of patients. Small quantities of opaque medium, however, could usually be detected in the parenchymal branches of the pulmonary arteries. In 11 of the 13 cases, increased vascular markings within the lungs were demonstrated by conventional roentgenography, and in 5 of these hilar pulsations were noted. It is therefore rather characteristic in transposition of the great vessels to have large, pulsating vascular structures within the lung which fill with insignificant quantities of contrast substance at the time of angiocardiography. Where there is an associated pulmonic stenosis, the vascular markings are, of course, inconspicuous and do not fill with any detectable amounts of opaque medium (Cases 1 and 2, Group VI).

It should be emphasized that, since the pulmonary artery is not usually visualized, its origin is diagnosed by inference only. If the right ventricle clearly fills with contrast substance and filling of the pulmonary artery does not follow, one assumes that the pulmonary artery does not communicate directly with the right ventricle. By inference then it must communicate with the left ventricle. Such an inference, of course, is not always valid. The pulmonary artery might override the ventricular septum by a slight to moderate degree, or a stenotic pulmonary artery could communicate directly with the right ventricle. In either case there would be minimal filling of the pulmonary artery. A case in which the pulmonary artery overrode the ventricular septum has been observed and reported by Taussig and Bing (16). In this case there was only slight opacification of the pulmonary artery. The contour of the heart, however, was somewhat different than that seen in complete transposition; here there was a convexity in the region of the pulmonary artery segment. Nevertheless, differentiation by angiocardiographic means between partial overriding and complete transposition of the pulmonary artery may be difficult. If, however, the overriding is other than minimal, the pulmonary artery may fill with sizable quantities of the opaque medium, and this has been observed by us in at least 2 other cases of this condition.

Cardiac enlargement, which is usually progressive, has generally been considered as one of the diagnostic features of transposition of the great vessels (14, 15). Significant cardiac enlargement was present in 9 of the 13 cases in the present group. In 1 case (Case 1, Group III) enlargement was questionable, and in the 3 other cases (Case 3, Group III and Cases 1 and 2, Group VI) the heart was definitely not enlarged. It is in this group where the heart fails to enlarge that most difficulties in diagnosis occur.

The contour of the heart in 10 of the 13 cases was closely identical to Taussig's (14, 15) descriptions of transposition of the great vessels. There is no doubt that the presence of this typical contour is of great importance in leading one to suspect the presence of a transposition. In 3 cases (Case 3, Group VII and Cases 1 and 2, Group VI), however, the deviation from the usual contour was quite pronounced, and in these the greatest problems in diagnosis arose.

The presence of a sizable interatrial septal defect could be detected with considerable reliability by angiocardiography. There were at least two exceptions in the present series. In Case 1, Group VI, there was good evidence of a patent foramen ovale which was large enough to "admit a 1-cm. probe," but this was not recognized at the time of the examination. In Case 1, Group V, there was an 8-mm. patent foramen ovale, yet the angiocardiograms provided no evidence of this. One wonders if during life the valves over these foramina were not more competent than was evident at autopsy. In general, where the defect measured 3 mm. or less, it was not demonstrated, although one defect of 4 mm. (Case 2, Group VI) was clearly shown. Defects as large as that demonstrated in Case 1.

Group I, will probably always be visible.

There was direct evidence of an interventricular septal defect in only one case (Case 2, Group VI), although the presence of such a defect was correctly inferred in several others. Apparently, if the patient survives longer than a few years, an interventricular septal defect is usually present. Also, if no interatrial septal defect can be demonstrated, the chances are good that an interventricular defect exists. Angiocardiographically, however, such a defect is usually not demonstrated and is seldom well seen.

Case 2, Group VI, was an exceptional example of an interventricular defect so large (2 cm.) that both ventricles opacified almost simultaneously. More rapid filming might have given a clue to the nature of the defect. At the time of the examination we were not certain whether the right ventricle filled alone or whether both ventricles were outlined. This, of course, tended to obscure the diagnosis.

Angiocardiography failed to demonstrate a concomitant patent ductus in 3 cases in which such a structure was proved to be present and to be at least 3 mm. in diameter. There are at least two probably valid reasons for this. The pressure gradients between the aorta and pulmonary artery are never very large and consequently the volume of the blood shunted through the ductus never approaches that seen in an uncomplicated patent ductus arteriosus. Also, the direction of the shunt may change frequently in order to equalize the pressure between the two circulations, thus greatly reducing the chances of opacification of the ductus and the pulmonary arteries. Even when the pulmonary arteries opacify, it cannot be inferred that they have filled from a ductus. In addition, the ductus is surrounded by and superimposed on a number of other vascular structures so that it cannot usually be identified with certainty on the angiocardiogram. Consequently angiocardiography has been of almost no value in demonstrating a patent ductus associated with a complete transposition. So far, this shortcoming has been of no great practical significance.

There have been no deaths due to angiocardiography in the present group of 13 patients or in an additional group of 38 patients in whom a transposition of the great vessels was thought to be present but not yet proved by autopsy. Even though most of the patients were severely incapacitated, they tolerated the procedure well and showed only a transient period of discomfort. In every case there was an immediate high concentration of the contrast substance in the aorta and presumably in the coronary arteries. In Case 2, Group III, the coronary arteries were apparently visualized. This tends to support the assumption that diodrast *per se* is not particularly toxic to the myocardium. Electrocardiographic studies were not made, but there were no clinically perceptible changes in the rhythm of the heart following the injection of the diodrast. In older patients with some disease of the coronary arteries, there may be other factors which may produce an untoward effect. Nevertheless, it appears that angiocardiography does not present any unusual hazards to the patient with transposition of the great vessels.

It is difficult to evaluate precisely the contributions of angiocardiography toward the diagnosis and treatment in this group of cases. In 10 of the 13 cases described, the presence of transposition of the great vessels was suspected from routine clinical, electrocardiographic, and roentgenographic studies prior to angiocardiography. The role of angiocardiography in these instances, therefore, was one of confirmation. In a number of cases, however, which have not come to autopsy and are therefore not included in this series, the diagnosis was made where it had not been previously suspected. Even when angiocardiography confirms a previously suspected diagnosis, its value is considerable, since it reassures the clinician who is preparing to submit his patient to a major surgical procedure.

It should be emphasized that the angiocardiographic findings were usually quite

definite and would have been sufficient to establish a diagnosis independently of other findings. Pulmonic stenosis was correctly diagnosed in the 2 cases in which it was present. In the 3 cases in this series in which a transposition was not suspected, angiocardiography did not lead to a correct diagnosis. In retrospect, it can be seen that in Case 3, Group III, and in Case 1, Group VI, the position and size of the aorta were quite suggestive of complete transposition. A lateral view was not available in Case 2, Group VI; the position of the aorta, therefore, could not be determined. Particularly in Case 3, Group III, the presence of the prominent vascular markings in the lungs associated with an anteriorly placed aorta would in the light of our present knowledge certainly lead to a diagnosis of transposition. We believe that our past experience will help greatly to improve the value of the procedure in establishing the diagnosis in future cases of transposition of the great vessels.

The practical value of angiocardiography in demonstrating the presence and size of interatrial defects is considerable. Surgery has not been performed in any case where angiocardiography demonstrated a large defect (Case 1, Group I). Usually when no defect was demonstrated, the patent foramen ovale was 3 mm. or less in size. There was one exception in which the defect was found at autopsy to measure 8 mm. The reason for this failure is still not clear, but it appears to be exceptional. Certainly if the defect is so large that surgery cannot make it appreciably larger, it will be demonstrated by angiocardiography.

From the information at hand it appears that angiocardiography provides information which permits cases of transposition of the great vessels to be divided into the following three groups.

I. Transposition of the great vessels in which the concomitant anomalies are not directly demonstrated. The presence of a sizable interatrial defect can usually be excluded, and occasionally the presence of an interventricular defect can be inferred.

II. Transposition of the great vessels in which a sizable interatrial defect is demonstrated as a concomitant anomaly.

III. Transposition of the great vessels in which pulmonic stenosis is demonstrated as a concomitant anomaly. Groups II and III may, of course, be seen in combination.

SUMMARY

A short discussion of the abnormal anatomy and physiology of the circulation associated with complete transposition of the great vessels is given.

The angiocardiographic findings in 13 proved cases of complete transposition of the great vessels are presented. These are classified according to the presence of associated anomalies, such as interatrial or interventricular septal defects, a patent ductus arteriosus, or a combination of these defects. The contributions of the procedure are evaluated according to its ability to (*a*) establish a diagnosis of transposition of the great vessels and (*b*) to detect the presence and size of the concomitant anomalies.

It was found that the angiocardiographic findings were sufficient to make the diagnosis of complete transposition of the great vessels in 10 of the 13 cases presented. The diagnosis had been suspected, however, from routine clinical and roentgenographic findings before these patients were subjected to angiocardiography.

In 3 cases where the diagnosis was not suspected, angiocardiography failed to clarify the issue. In each instance there were bizarre features which rendered the diagnosis more difficult.

The presence and size of a significant associated interatrial defect can be determined with a fair degree of reliability by angiocardiography. If the defect is so large that further enlargement by surgery is not indicated, we believe it will always be demonstrated by a technically satisfactory angiocardiogram. Concomitant interventricular defects rarely were directly demonstrated. Occasionally their

presence could be inferred from associated findings.

Angiocardiography failed to demonstrate a patent ductus arteriosus in 4 cases in which the ductus proved to be over 3 mm. in diameter. The possible reasons for this failure are discussed.

There were no angiocardiographic deaths or severe reactions in 52 patients who were thought to have a complete transposition of the great vessels (13 proved cases).

The difficulties in differentiating a complete transposition from a complete transposition of the aorta with a levoposition of the pulmonary artery are discussed. Other limitations and shortcomings of the procedure are considered.

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SUMARIO

La Angiocardiografía en la Cardiopatía Congénita de Forma Cianótica. III. Observaciones sobre la Transposición Total de los Grandes Vasos

En la transposición total de los grandes vasos, la aorta tiene su origen completamente en el ventrículo derecho y recibe sangre venosa de la circulación general; la arteria pulmonar parte del ventrículo izquierdo y recibe sangre muy oxigenada. En los casos corrientes, en que no hay mayor rotación del corazón, la aorta se encuentra, pues, enfrente y la arteria pulmonar atrás. La sangre no saturada con oxígeno de la aorta va a parar a la circulación general y vuelve al lado derecho del corazón. La sangre oxigenada de la arteria pulmonar se distribuye a los pulmones y vuelve al lado izquierdo del corazón. Las dos circulaciones son, pues, distintas, salvo por ciertos defectos compensadores que son de rigor para que continúe la vida.

Esta presentación comprende los hallazgos angiocardiográficos en 13 casos comprobados de transposición total de los grandes vasos. Los mismos son clasificados conforme a las anomalías concomitantes, tales como imperfección del tabique interauricu-

lar o interventricular, permeabilidad del conducto arterioso, o combinación de ambas imperfecciones.

Los hallazgos angiocardiográficos bastaron para la formulación del diagnóstico de transposición total de los grandes vasos en 10 de los 13 casos estudiados. Sin embargo, antes de someter al enfermo a la angiocardiografía, ya se había sospechado el diagnóstico en esos casos por virtud de los hallazgos clínicos y radiográficos obtenidos sistemáticamente.

En 3 casos en que no se sospechó el diagnóstico, la angiocardiografía no esclareció el punto. En todos éstos había características extrañas que dificultaban el diagnóstico.

La presencia y el tamaño de una importante brecha interauricular presente pueden ser determinados con bastante exactitud por la angiocardiografía. Si la misma es tan grande que no esté indicada mayor ampliación con la cirugía, parece que la descubrirá siempre un angiocardiograma técnicamente satisfactorio. Rara vez se descubrieron directamente las brechas interventriculares concomitantes, pero a veces se pudo inferir su presencia por los otros hallazgos.

La angiocardiografía no descubrió un conducto arterioso permeable en 4 casos en que el mismo resultó tener más de 3 mm. de diámetro. Las posibles causas del fracaso aparecen discutidas

No hubo muertes o graves reacciones debidas a la angiocardiografía en 52 enfermos que parecían tener transposición total de los grandes vasos (comprobada en 13).

Discútense las dificultades encontradas al diferenciar una transposición total de una transposición total de la aorta con levoposición de la arteria pulmonar. También se consideran otras limitaciones y deficiencias del procedimiento.

Dental Roentgenologic Manifestations of Systemic Disease

II. Developmental Disturbances[1]

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INHERITANCE factors play an important part in many developmental disturbances. In some instances symptoms may be present at birth; in others they may develop during childhood or adolescence. Those disturbances which have their onset in adolescence produce, in general, dental changes which are less severe than do those which are congenital. The dental disturbance may be manifested mainly by faulty dental structure, interference with normal eruption of the teeth, and malocclusion. Most of the developmental disturbances which have an effect upon dentition are those which involve the skeleton. More rarely the dental defects may be of ectodermal origin, of which the most common is probably ectodermal dysplasia.

OSTEOGENESIS IMPERFECTA (FRAGILITAS OSSIUM)

Osteogenesis imperfecta, which is a disturbance of mesenchymal development, is primarily characterized by brittle bones and may be associated with blue sclerae and deafness. The disease may be hereditary or non-hereditary; the etiologic factor is probably some inherent defect in the germ plasm, which may be hereditary or sporadic.

Any disturbance of dental development which might be present would depend largely upon the time of appearance of the symptoms, and would occur in the fetal or infantile cases. The dental abnormality most often seen is very similar to dentinogenesis imperfecta (hereditary opalescent dentin), a condition which may be peculiar to the teeth. It has been described by Hodge and co-workers (1), Roberts and Schour (2), and others, and is characterized by an amber color of the teeth, absence of pulp chambers and canals, and imperfectly formed dentin. Reference to the yellowish or amber color and translucency of the teeth in osteogenesis imperfecta has been made by Colyer and Sprawson (3) and by Mittelman (4). Becks (5), who made histologic studies of tooth structure in a case of osteogenesis imperfecta, found a poorly calcified granular dentin and absence of pulp canals and odontoblastic processes.

The dental roentgenogram shown in Figure 1 is that of an eight-year-old girl who at eleven days of age had experienced the first of many fractures of the bones, and also had blue sclerae. This case was included in a series of 40 cases of osteogenesis imperfecta reported by Bickel and coworkers (6), but the dental findings were not described. The anterior teeth had a translucent appearance and were of light amber color. The crowns of the teeth were of normal size, and the premolars present were undergoing premature eruption, probably as a result of early loss of the primary molars. The roentgenogram revealed congenital absence of the two upper left premolars. The bone of both jaws was slightly osteoporotic.

The typical developmental pattern which is followed in dentinogenesis imperfecta is in evidence. In the incisor and first molar teeth, which are the earliest to undergo complete formation, the pulp chambers have been replaced completely by dentin, and the pulp canals, particularly of the lower incisors, are almost completely obliterated. In the premolars calcification of the roots is limited to a thin wall of dentin which has extended away from the coronal portion to form the contour of the

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[1] From the Section of Dentistry, Mayo Clinic, Rochester, Minn. Presented in part at the Thirty-seventh Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 2–7, 1951.

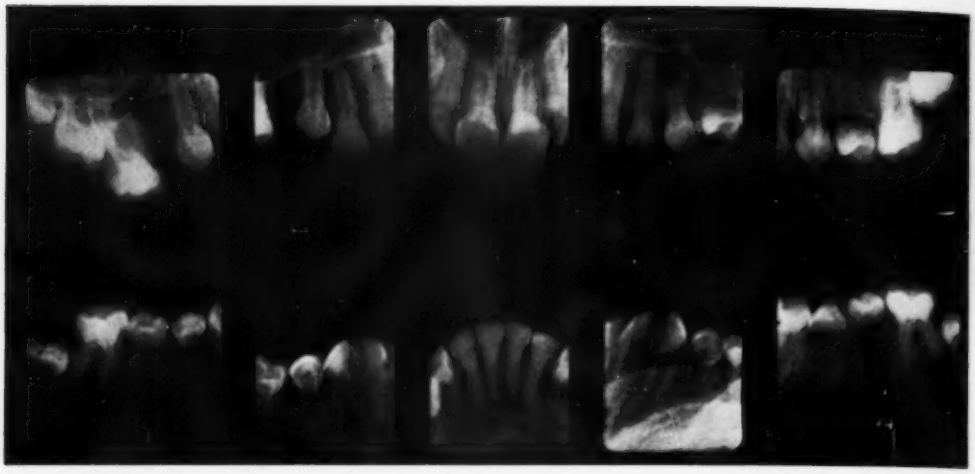

Fig. 1. Osteogenesis imperfecta with dentinogenesis imperfecta in a girl eight years of age. There is characteristic early obliteration of the pulp chambers of the incisor and first molar teeth.

Fig. 2. Osteopetrosis (Albers-Schönberg disease) in a man twenty-eight years of age. Abnormal density of bone, absence of marrow spaces and small underdeveloped roots of the teeth are evident. (Reproduced, with permission, from Stafne, E. C.: Dental Roentgenologic Aspects of Systemic Disease. J. Am. Dent. A. **40:** 265–283, March 1950.)

roots. The large radiolucent space within the thin walls probably will gradually fill with calcified substance to the extent that only a remnant of pulp canal may remain and present a picture similar to that of the incisor teeth which had undergone development earlier.

OSTEOPETROSIS (ALBERS-SCHÖNBERG DISEASE)

Osteopetrosis is characterized by a generalized osteosclerosis and elimination of bone marrow caused by a reduction in osteoclastic activity. According to Pancoast, Pendergrass and Schaeffer (7), the long bones, ribs, pelvis, skull, and spinal column are most commonly involved. The disease is hereditary and, while usually congenital, it may also develop in postnatal life. Higinbotham and Alexander (8) have reported 4 cases in one family.

The bone is of very poor quality and fragile, and therefore fractures are not uncommon. There is decreased resistance to infection and, because of the common occurrence of superimposed periodontal and periapical infection, the jaws are particularly subject to osteomyelitis.

Disturbances of dentition may occur in congenital cases or those developing early

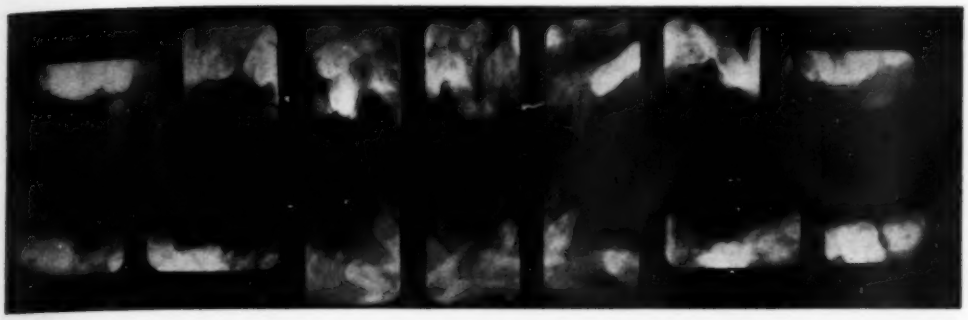

Fig. 3. Achondroplasia in a man thirty years of age: non-eruption of twenty permanent teeth and inclusion of primary molars. (Reproduced, with permission, from Stafne, E. C.: Dental Roentgenologic Aspects of Systemic Disease. J. Am. Dent. A. **40:** 265–283, March 1950.)

in postnatal life. The disease is manifested by structural defects as well as retardation of development and eruption. A dental roentgenogram revealing developmental defects of the teeth in a man twenty-eight years of age, who had osteopetrosis, is shown in Figure 2. The disease is evidenced by the small underdeveloped roots of the nine maxillary and six mandibular teeth which still remain, and also by obliteration of the pulp chambers. The missing teeth had become loose and had exfoliated spontaneously. The roentgenogram also shows the bone of the jaws to be abnormally dense, particularly in the mandible, where there are no apparent marrow spaces in the anterior and premolar regions. Whether sclerosis of the bone with reduced circulation was responsible for incomplete development of the roots of the teeth in this case is problematic. That inheritance is a factor is evidenced by the fact that a brother, who also suffered from osteopetrosis, had a similar dental anomaly and as a result had lost his teeth at an early age.

ACHONDROPLASIA

Achondroplasia is a disease in which disturbance of the development and formation of cartilage is the primary feature. The cause is not known, and there is a marked hereditary tendency. The extremities are short in comparison to the torso, because of a lack of growth at the epiphyses of the long bones. Among other characteristics are retruded maxilla, saddle nose, and prominent forehead.

Interference with dental development and eruption is not infrequent, and is most often manifested by a tendency to retarded eruption and to non-eruption of the teeth. Structural defects of the teeth are rare, though Miller (9) has reported a case in a girl thirteen years of age, in whom the crowns of three maxillary incisors were cone-shaped. There were also partial anodontia and retardation of development and eruption.

The dental roentgenogram of an achondroplastic dwarf thirty years of age, illustrating non-eruption of teeth, is shown in Figure 3. It revealed twenty embedded permanent teeth, and also five embedded primary molars that had undergone almost complete resorption. The primary molars probably had originally erupted, but their roots had become ankylosed and the teeth had become embedded as a result of inclusion by the growth and increase in dimension of the alveolar process which followed. With the exception of a small rudimentary right maxillary third molar, the teeth were of normal size. The presence of so many unerupted teeth presents a picture which is very similar to that seen in cleidocranial dysostosis. Both jaws were similarly affected.

CLEIDOCRANIAL DYSOSTOSIS

Cleidocranial dysostosis, which is usually a developmental disturbance of hered-

Fig. 4. Cleidocranial dysostosis in a girl thirteen years of age: prolonged retention of the primary teeth, noneruption of the permanent teeth, and four supernumerary premolar teeth. (Reproduced, with permission, from Millhon, J. A. and Austin, L. T.: Dental Findings in Four Cases of Cleidocranial Dysostosis. Am. J. Orthodontics (Oral Surg. Sect.) **30:** 30–40, January 1944.)

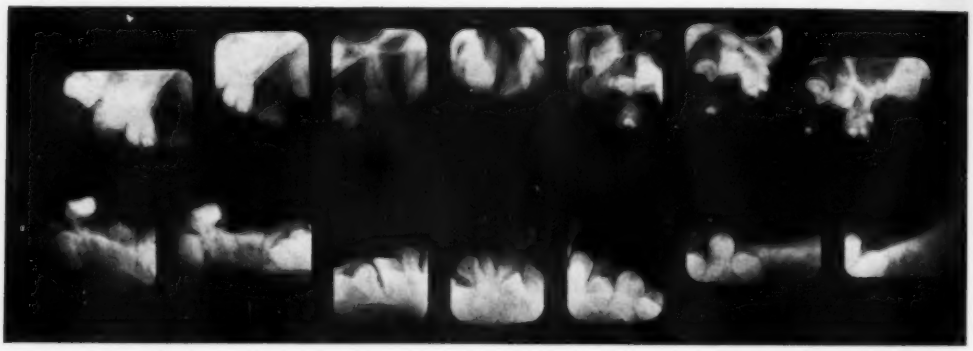

Fig. 5. Cleidocranial dysostosis in a woman thirty-two years of age. There are eleven maxillary and ten mandibular unerupted teeth.

itary origin, is characterized by delayed ossification of the fontanels, complete or incomplete aplasia of the clavicles, malformation of the craniofacial bones, and abnormalities of the teeth and jaws; occasionally other bones may be either stunted or overdeveloped.

Abnormality of the teeth and jaws, which is almost a constant feature, is characterized by underdevelopment of the maxilla, delayed resorption of the roots of the primary teeth, failure of eruption of the permanent teeth, and the presence of supernumerary dental structure. A roentgenogram illustrating all the dental features is shown in Figure 4. This roentgenogram was selected from 4 cases of cleidocranial dysostosis reported by Millhon and Austin (10). It is that of a girl thirteen years of age with craniofacial and clavicular defects and also involvement of the terminal phalanges of the thumbs and toes. There was prolonged retention of almost all the primary teeth, some of them for at least six years beyond the normal time for shedding; however, the roots of the upper anterior and some of the posterior teeth had undergone resorption, suggesting that they would soon be exfoliated. All the permanent teeth, including the first and second molars for which there are no predecessors, still remained unerupted. The roentgenogram revealed the presence of four supernumerary bicuspids, one being situated in each quadrant.

While primary teeth invariably will be lost by the time the patient reaches adult life, most of the permanent teeth fail to erupt. A dental roentgenogram made for a patient thirty-two years of age is shown

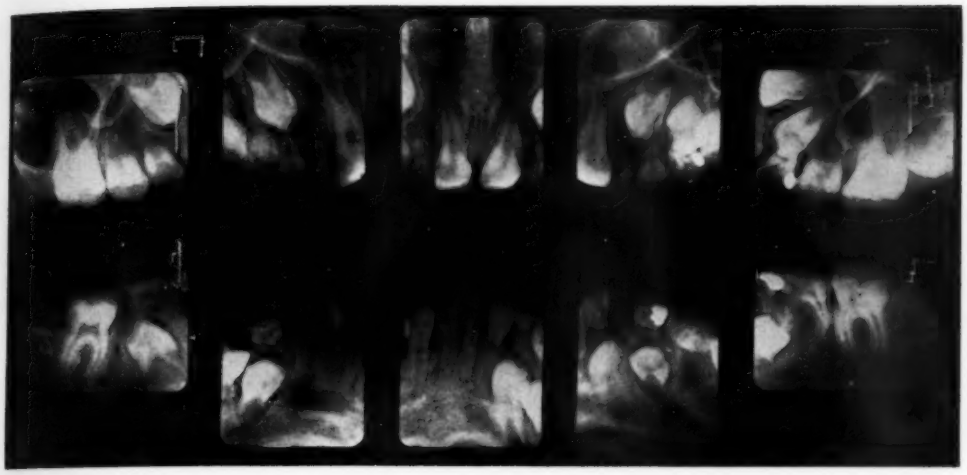

Fig. 6. Hypertelorism. Roentgenogram of a girl nine years of age, showing absence of the permanent maxillary lateral incisors, three premolars and left second molar, and the mandibular second premolars, second molars and left canine.

in Figure 5. Eleven maxillary and ten mandibular teeth still remain unerupted. Failure of the permanent teeth to erupt is probably due to the quality or character of bone, which fails to resorb in response to the eruptive force.

HYPERTELORISM

Hypertelorism is regarded by Greig (11) as a definite variety of craniofacial dysostosis. It is a congenital malformation of the skull, familial in origin and characterized by an abnormally great separation of the eyes and by broadening and deformity of the nose. According to Washington (12) the abnormality results in an increased width of the lesser wings and underdevelopment of the greater wings of the sphenoid. The oversized lesser wings may be responsible for the broadening of the nasal region. Other malformations which have been noted are underdevelopment of the pituitary fossa, absence of the anterior part of the nasal septum, incomplete development of the alveolar process of the maxilla, and underdevelopment of the mandibular ramus.

Greig, who studied the skull of a patient with hypertelorism dying at the age of twenty-two years, observed that the upper alveolar margin, which is normally situated an appreciable distance below the zygomatic bones, was situated above the lower borders of these bones. At the nasal margin the left maxilla measured vertically only 2.5 mm. The second and third molars were the only teeth remaining. Three of these were carious, the right third molar being unerupted. Whether all the permanent teeth had at one time been present is probably uncertain.

The dental roentgenogram of a patient nine years of age who had hypertelorism is shown in Figure 6. It revealed an absence of the maxillary left lateral incisor, first and second premolars, second molar, and the right lateral incisor and second premolar. The mandibular teeth which failed to develop were the left canine, second premolars, and second molars. The maxillary arch was short and abnormally broad, with pronounced lateral displacement of the posterior teeth.

Another case of hypertelorism was that of a patient eighteen months of age, in which it was not possible to obtain satisfactory intra-oral roentgenograms. From anteroposterior and lateral roentgenograms of the head, however, a good view of both jaws was obtained. They revealed the normal number of primary teeth and also the permanent first molars, in which hard-

Fig. 7. Unilateral hyperplasia of the face (facial giantism). Roentgenogram of a boy five years and four months of age, showing premature development and eruption of teeth on the right side. The abnormally large maxillary first premolar and first molar and mandibular canine and first premolar are shown.

tissue formation begins at birth and an appreciable amount of enamel has formed at eighteen months of age. There is no roentgenographic evidence, however, of either the tooth follicles or calcification of the crowns of the incisors or canines, teeth in which, with the exception of the maxillary lateral incisor, hard-tissue formation normally begins prior to six months of age. It is possible that the development of these teeth was merely retarded, but this is doubtful.

The apparent dental anomaly in these 2 cases of hypertelorism is the absence of thirteen of the permanent teeth in one instance and an absence of twelve in the other. Whether absence of teeth is a constant feature in hypertelorism probably cannot be concluded from the observations made in 2 cases, but the evidence is suggestive. If so, it is in direct contradistinction to dental anomalies associated with the craniofacial abnormalities of cleidocranial dysostosis, in which not only the normal number of teeth but supernumerary dental structures as well are present. It is also of interest to note that in both hypertelorism and cleidocranial dysostosis, the dental abnormalities are not confined to the maxilla but involve the mandible as well.

UNILATERAL HYPERPLASIA OF THE FACE (FACIAL GIANTISM)

Facial giantism is a rare developmental disturbance, the cause of which is unknown. According to Rushton (13), the tissues affected are those which arise from the first branchial arch; also there may be unilateral enlargement of the tongue, mastoid process, and ear. He reported the case of a boy five and a half years of age with an enlargement of the cheek, lip, nostril, ear, maxilla, and mandible on the right. The permanent teeth were erupting prematurely on the involved side, some were absent, and some were of abnormally large size. Rushton also referred to 3 cases from the literature in which there were enlarged teeth. Later he reported the case of a boy sixteen years of age with four abnormally large teeth on the involved side (14).

I have had an opportunity to observe 2 patients with giantism of the face presenting similar dental findings. A dental roentgenogram made in 1 of these, a boy five years and four months old, is shown in Figure 7. Enlargement of the right side of the face had been noticed shortly after birth. On the left, the primary teeth were still in place and the permanent teeth were at a stage of development which conformed

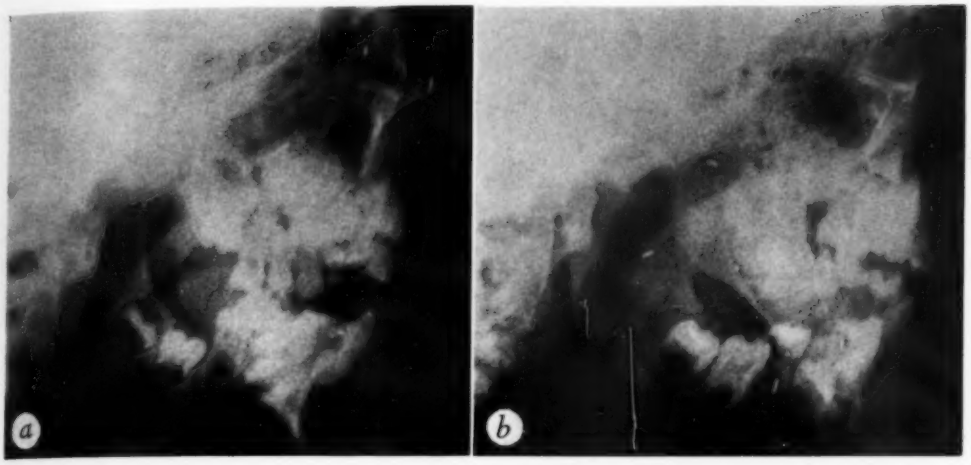

FIG. 8. Unilateral hyperplasia of the face. Lateral roentgenograms of the jaw from the case illustrated in Fig. 7. *a*. View of the left side, which is normal. *b*. View of the right side, showing overdeveloped and enlarged mandible, premature development and eruption, and four abnormally large teeth.

with the child's age. On the right, the involved side, the primary molars and the primary maxillary canine were on the verge of shedding, and development of permanent teeth, with the exception of the maxillary central and lateral incisors, was several years in advance of the chronologic age. The maxillary first molar and the mandibular central incisor and canine had erupted. The maxillary canine, first premolar and first molar, and the mandibular canine and first premolar were abnormally large. The mandibular lateral incisor and both second premolars were absent; whether the failure of these teeth to develop was caused by irradiation which had been given on the assumption that the condition was a lymphangioma is uncertain, since absence of teeth is also a characteristic of that disease.

The most striking dental feature in partial giantism of the face is the apparently consistent occurrence of macrodontia. Other disturbances which produce an acceleration of development with overgrowth of the skeletal structures do not affect the size of the teeth, with the possible exception of hyperpituitarism, in which only the roots of the teeth may be abnormally large. The association of partial facial giantism with premature development and eruption and with macrodontia in jaws which are larger on the involved side may be a means of differentiating it from tumors and other conditions which produce enlargement of the face. To illustrate this point, lateral view roentgenograms of the left and right sides of the mandible are shown for comparison in Figure 8. Figure 8*a* is a view of the left side, which is the normal one. The age of dental development conforms to the chronologic age, and the teeth and body of the mandible are of normal size. Figure 8*b* gives a view of the right or involved side. Here the mandible is appreciably larger than on the opposite side. The teeth are developing far in advance of those on the left, and the first premolar and first molar are abnormally large. While these roentgenograms were made when the patient was five years of age, the enlarged mandible and premature dental development would, no doubt, have been apparent and a correct diagnosis could have been made at a much earlier age.

ECTODERMAL DYSPLASIA

Ectodermal dysplasia is characterized by partial or total absence of hair, absence or scantiness of sweat glands, partial or complete absence of teeth, and faulty finger-

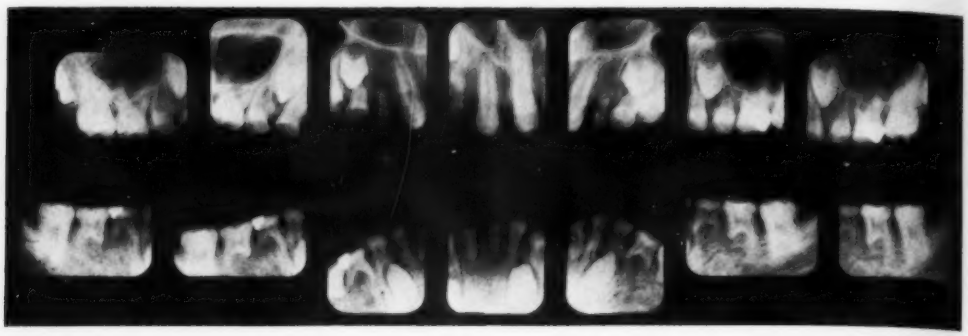

Fig. 9. Ectodermal dysplasia in a boy ten years of age: congenital absence of the mandibular incisors, premolars, and second molars, and the maxillary lateral incisors and premolars. (Reproduced, with permission, from Stafne, E. C.: Dental Roentgenologic Aspects of Systemic Disease. J. Am. Dent. A. **40:** 265–283, March 1950.)

nails. It is a disease of hereditary tendency. Dental aplasia may vary from absence of a limited number of the permanent teeth to total absence of both the primary and permanent teeth. Cases of ectodermal dysplasia in which there has been total anodontia have been reported by Guilford (15), Thoma and Allen (16), and Lovestedt (17). Cook (18) reported the case of a boy nineteen years of age in whom the permanent maxillary canines and first molars only were present.

The degree of dental aplasia probably depends upon the time of onset of the ectodermal disturbance. When it occurs early in fetal life, there may be total aplasia; with a later disturbance, the primary teeth may remain unaffected, but all or a few of the permanent teeth may fail to develop. The teeth which are most apt to remain unaffected are those for which the anlage is first laid down, that is, the incisors, canines, and first molars.

A dental roentgenogram which illustrates a case of partial anodontia is shown in Figure 9. It is that of a boy ten years of age with a dry skin which was sensitive to sunlight, scarcity of hair on the arms and body, very little sweating, and slight defects of the fingernails. The roentgenogram revealed congenital absence of the four mandibular incisors, premolars, and second molars, and the maxillary lateral incisors and premolars. All the primary teeth with the exception of the maxillary incisors were still in place. Because of the mild degree of ectodermal symptoms and the chronologic age at which interference with dental development occurred, it might be presumed that the ectodermal disturbance occurred late in fetal life.

A dental roentgenogram illustrating total dental aplasia is shown in Figure 10. It is that of a man twenty-three years of age in whom the ectodermal disturbance was more severe than in the previous case. The dental findings were previously reported by Lovestedt (17). The primary as well as the permanent teeth had failed to develop, and artificial dentures had been worn for a period of fourteen years. Both jaws were small and underdeveloped, particularly the mandible. The roentgenographic appearance is similar to that sometimes seen in the senile edentulous jaw, in which the alveolar process has undergone complete resorption following loss of the teeth. In instances of total anodontia, however, there is no need for the alveolar process, and it therefore fails to develop.

COMMENT

In many of the developmental disturbances for which characteristic dental findings have been discussed, such findings may not aid appreciably in arriving at a correct diagnosis, particularly where the condition is advanced and severe. In instances where the disturbance is mild, how-

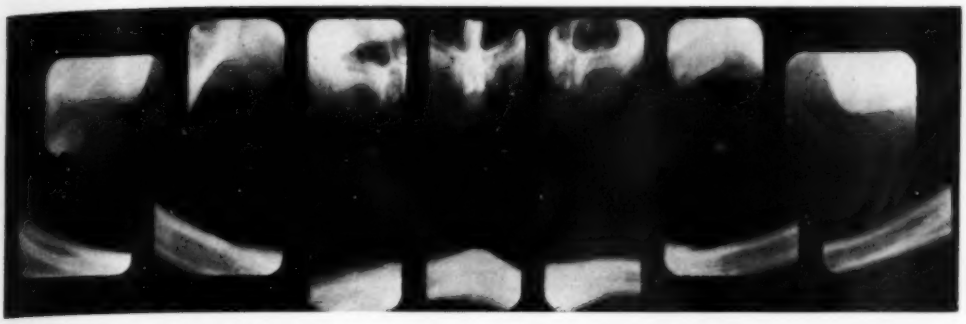

Fig. 10. Ectodermal dysplasia in a man twenty-three years of age. There are total dental aplasia and marked underdevelopment of the alveolar process. (Reproduced, with permission, from Lovestedt, S. A.: Examples of Dental Dysplasia. Am. J. Orthodontics (Oral Surg. Sect.) **33:** 625–629, August 1947.)

ever, the dental picture may provide a clue leading to a diagnosis, such as dental aplasia in the milder cases of ectodermal dysplasia or in cases of cleidocranial dysostosis where there is only partial aplasia of the clavicles and the craniofacial deformity is not too marked.

In hemihypertrophy of the face, the dental condition is one which should be of definite value in differential diagnosis. Premature development and eruption of teeth and macrodontia of the involved side are peculiar to this condition and should serve to differentiate it from tumors and other conditions producing facial enlargement. Furthermore, the diagnosis could be made on a roentgenologic basis early in infancy.

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(Para el sumario en español, véase la página siguiente.)

SUMARIO

Manifestaciones Roentgenológicas de las Afecciones Orgánicas en la Dentadura

La mayor parte de los trastornos del desarrollo que afectan la dentición son los que comprenden el esqueleto. Más raramente, las deficiencias dentales pueden reconocer origen ectodérmico.

En la *osteogénesis imperfecta*, la anomalía odontológica observada más frecuentemente es semejante a la dentinogénesis imperfecta, consistiendo en color ambarino de los dientes, falta de las cámaras y conductos de la pulpa y formación imperfecta de la dentina.

En la *osteoporosis* congénita o postnatal temprana, obsérvanse deficiencias de los tejidos dentarios, así como retardo del desarrollo y salida de los dientes.

La *acondroplasia* va frecuentemente acompañada de impedimentos en la formación y salida de los dientes, traduciéndose más a menudo por retardo o falta de la salida de los mismos. Las deficiencias de los tejidos dentarios son raras.

Las anomalías de los dientes y mandíbulas son característica casi constante de la *disostosis cleidocraneal*. Las habituales son: hipoplasia de la mandíbula superior, reabsorción tardía de las raíces de los dientes de leche, falta de salida de los permanentes y presencia de tejidos dentarios supernumerarios.

De los 2 casos de *hipertelorismo* observados, uno reveló falta de 13 y el otro falta de 12 de los dientes permanentes, pero no hay certeza con respecto a si se trata o no de una característica constante.

En el *gigantismo facial*, la más notable característica dentaria consiste en la aparentemente constante ocurrencia de macrodoncia unida a hiperplasia de las mandíbulas del lado afectado y salida y desarrollo prematuros de los dientes.

La aplasia dentaria forma parte del síndrome de la *displasia ectodérmica*. Puede que no falte más que un pequeno número de los dientes permanentes o que falten por completo tanto los temporales cuanto los permanentes

En muchas de las enfermedades del desarrollo para las que se han descrito típicos hallazgos odontológicos, puede, que éstos no sean de valor apreciable en el diagnóstico, máxime si el estado se halla avanzado. Sin embargo, en los casos en que el trastorno es leve, el cuadro dentario puede aportar una clave que conduce al diagnóstico acertado.

Roentgen Studies of the Maxillae and Mandible in Sickle-Cell Anemia[1]

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THERE ARE A number of excellent reports describing the roentgenographic changes in the skull and long bones in sickle-cell anemia (1–14). No reference, however, has been made to the jaws. The purpose of this preliminary report is to describe the roentgenographic findings in the mandible and maxillae in patients with this type of anemia.

FEATURES OF SICKLE-CELL ANEMIA

Definition and Incidence: Sickle-cell anemia is an hereditary and familial form of chronic hemolytic anemia with excessive red blood cell destruction, as well as excessive red blood cell formation as evidenced by hyperplasia of the bone marrow. The disease occurs almost solely in Negroes, and is without sex preference. Elongated crescent or sickle-shaped erythrocytes approximately 15 microns in length are found in the blood stream.

The sickle-cell trait, a dominant asymptomatic finding, was present in 7.3 per cent of a series of 8,000 Negroes (15). It is transmitted in accordance with the mendelian law and becomes manifest clinically only when the number of abnormal erythrocytes is great enough. One out of 40 American Negroes with the sickling trait showed evidence of sickle-cell anemia (15).

Symptoms and Signs: The symptoms vary considerably, but in general the patient may complain of easy fatigability, weakness, shortness of breath, epigastric and hypochondrial pain, nausea, vomiting, and muscle and joint pains. The heart is usually dilated, as in most prolonged anemias. There is frequently a systolic murmur at the apex, representing relative mitral insufficiency. The spleen is commonly enlarged, although this is not a constant finding. Bone deformities such as kyphosis, scoliosis, saber shin, and the tower-shaped skull have also been described (7). During the "crisis" the patient becomes very ill, often writhes with pain, has a septic type of temperature and a high leukocyte count. The disease in its varied manifestations simulates many surgical conditions.

Pathologic Findings: The red bone marrow is soft, jelly-like, and uniformly dark-red or purplish-black in the flat bones of the trunk and calvarium and in the long bones. Microscopically, it is hyperplastic, as evidenced by increased cellularity and congestion.

In addition to the abnormal hematopoiesis and blood stasis, there is evidence of degenerative and reparative processes in the marrow. The findings include thrombosis, infarction, necrosis, hemorrhage, granular and crystalline pigment deposits, hyalinization, fibrosis, abnormal calcification, and new bone formation. The bone marrow lesions are similar to those in other organs of the body.

Roentgenographic Findings. Long Bones: The roentgenographic findings in the bones of the extremities have received the most attention. In children, the long bones may show widening of the medullary cavity, thinning of the cortex, prominent trabeculations, and occasionally periosteal elevation.

In late childhood and in adults, the bone involvement may change in some regions from marrow hyperplasia and congestion to thrombosis and subsequent fibrous tis-

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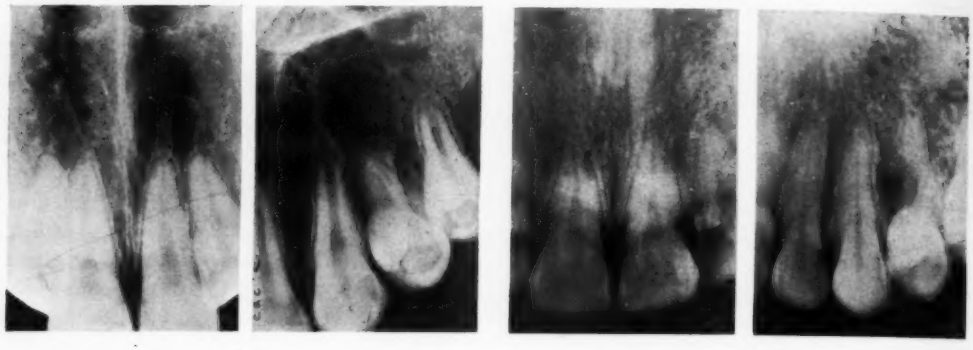
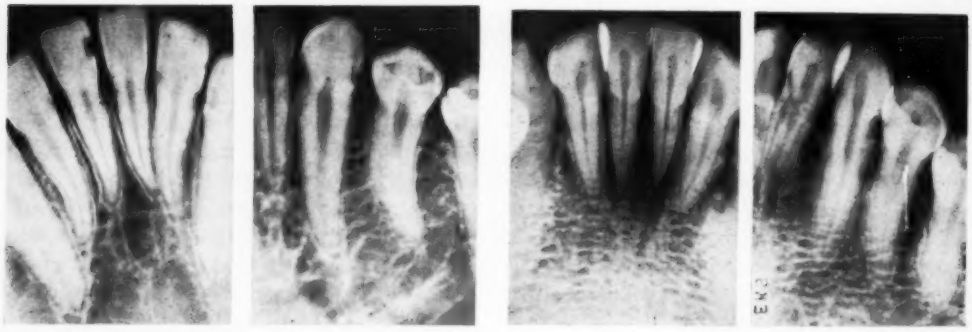


A B

Fig. 1. Dental roentgenograms of the maxillary incisor-bicuspid area. A. Patient with sickle-cell anemia. Note in the bone the increased radiolucency, decrease in the number of trabeculae with resultant increase in their prominence and the presence of large marrow spaces. Note also the intact lamina dura around the teeth. B. Roentgenograms of comparable areas in an apparently normal Negro patient.



A B

Fig. 2. Dental roentgenograms of the mandibular incisor-bicuspid area. A. Patient with sickle-cell anemia. Note the increased radiolucency and resultant prominence of the trabeculae. These are arranged horizontally, thus creating a stepladder-like effect, particularly in the alveolar bone. B. Roentgenograms of comparable areas in an apparently normal Negro patient.

sue replacement. In such cases, one may find sclerosis and cortical thickening at the expense of the medullary cavity. This may occur in any bone but is more common in the tibia and fibula, particularly in the presence of chronic leg ulcer. Some of the bones may show patchy irregularities in density and alteration in the pattern of bone architecture.

Skull: The skull changes usually described are: (*a*) increase in thickness; (*b*) pointed, perpendicular trabecular striations radiating outward from the inner table, giving a "hair-on-end" appearance; (*c*) absence of a well defined outer table; (*d*) a generalized osteoporosis (Fig. 4). The thickening of the diploë is bilaterally symmetrical, being maximal at the vertex and tapering to normal in the temporal region. This is usually limited to the parietal bone but may also involve the frontal and occipital bones. It is similar to that described in erythroblastic anemia, hemolytic jaundice, and in the skulls of ancient Mayan Indians (12). In many cases the vertex has a granular appearance, and in occasional instances there are round areas of increased radiability, varying in size and distribution and resembling somewhat metastatic cancer or multiple myeloma (5).

Bones of the Trunk: In the vertebrae the most common findings are osteoporosis and accentuation of the trabecular markings. The hyperplastic marrow and loss of calcium in the vertebrae lead to a decrease in

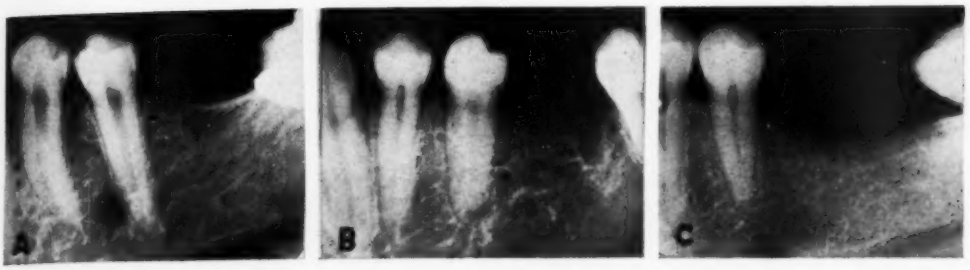


Fig. 3. Dental roentgenograms of mandibular bicuspid-molar area illustrating relative degrees of osteoporosis in patients with sickle-cell anemia (A and B) and a normal patient (C). A. Severe osteoporosis. Note the almost complete lack of trabeculations. B. Moderate osteoporosis. C. Normal Negro patient.

the height of the vertebral bodies. They become flatter and somewhat wider than normal. The intervertebral spaces are widened and bulge into the adjacent resorbed vertebral bodies, creating a biconcave deformity.

MATERIAL AND METHODS

Twenty-two Negro patients (10 females and 12 males), with an established diagnosis of sickle-cell anemia and ranging in age from ten to forty-six years, were studied.[4] The following methods were employed for each patient:

1. A complete medical history.
2. A clinical oral examination.
3. Complete dental roentgenograms, lateral jaw, and skull plates.

Comparable intra-oral roentgenograms of 100 apparently normal Negroes were used for comparative study.

OBSERVATIONS

Appearance of the Maxillae and Mandible in the Dental Roentgenograms: Eighteen of the 22 patients with sickle-cell anemia showed significant bone changes in the dental roentgenograms (Table I). The changes observed were in the form of a generalized osteoporosis. Because of a decrease in the number of trabeculae, there was an increased radiolucency of the dental roentgenogram. The remaining trabeculae, which were sharply defined, surrounded multi-sized and irregularly shaped marrow spaces (Figs. 1A, 3, 5). This osteoporosis was present in the alveolar bone as well as the spongiosa of the jaw bone proper.

TABLE I: ROENTGENOGRAPHIC CHANGES ACCORDING TO AREA STUDIED IN PATIENTS WITH SICKLE-CELL ANEMIA

Area Examined	Total Number of Patients	Number of Patients with Observable Changes
Jaws	22	18 (79.2%)
Long bones	22	3 (13.6%)
Skull	22	1 (4.5%)

The decrease in trabeculation appeared rather striking, especially in the alveolar bone between the roots of the teeth. In these areas the trabeculae appeared in horizontal rows, creating an accentuated stepladder-like effect (Fig. 2A). In areas where no teeth were present there was also a decrease in the number of trabeculae, but the parallel arrangement was not noted.

The lamina dura surrounding the roots of the teeth usually appeared distinct and dense (Figs. 1A, 2A, 5). The shape of the crowns and roots of the teeth and their periodontal attachment appeared to be normal. The medullary portion of the alveolar crest had an increased radiolucency and in some cases was indistinct, although the alveolar height appeared to be within normal range.

The osteoporosis ranged from a severe to a rather mild degree (Fig. 3; Table II). Three of the 22 patients presented extreme osteoporosis, giving the roentgenograms a markedly radiolucent appearance (Fig.

[4] The diagnoses were initially made at Cook County Hospital, Provident Hospital, and the University of Illinois Clinics of Chicago.

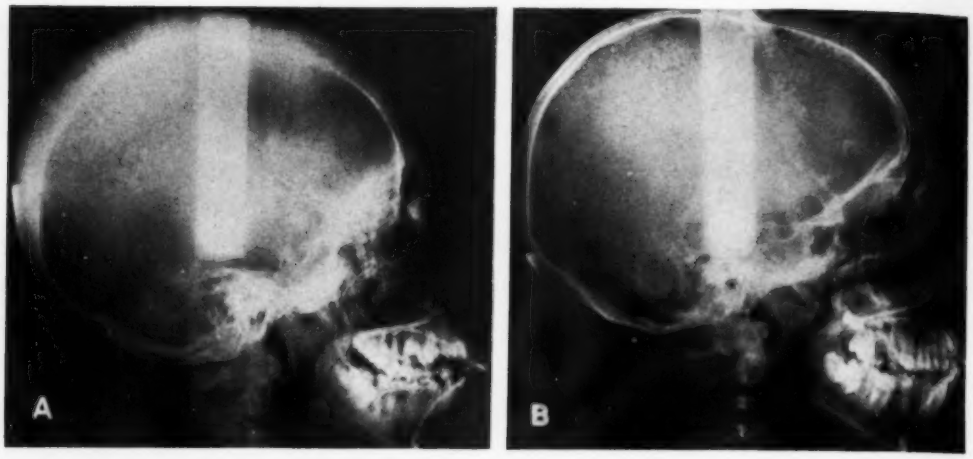


Fig. 4. Lateral roentgenograms of skulls of two brothers, each having sickle-cell anemia. A. Note the radial striations, thickening of the frontal and parietal bones, and the prominent diploë. B. Apparently normal roentgenogram.

3A). There were moderate bone changes in 8 patients and mild changes in 7. In 4 of the 22 patients the roentgenographic findings were essentially normal.

Of the 22 patients, 3 had significant findings in the roentgenograms of the long bones (Table I), namely a widening of the medullary cavity and thinning of the cortex with prominent trabeculations. One patient showed considerable destruction and deformity of the femoral necks. The hip joints of this same patient revealed alternate areas of bone proliferation and destruction.

One of the 22 patients displayed dramatic skull findings (Fig. 4A). There was a marked widening of the diploë and pointed trabecular striations radiating from the inner table to an indistinct outer table, giving the "hair-on-end" appearance.

TABLE II: DEGREE OF BONE CHANGES IN ROENTGENOGRAMS OF 22 PATIENTS WITH SICKLE-CELL ANEMIA
(+++ Severe. ++ Moderate. + Mild. − No abnormality)

Patient	Age (in years)	Dental Films		Lateral Jaw Films	Other Films
R. B.	10	+++		+++	+++ (Skull)
W. B.	12	+++	3	+++	−
E. P.	24	+++		++	−
J. R.	16	++		++	+ (Tibia)
K. T.	26	++		++	++ (Pelvis; tibia)
R. D.	46	++		++	−
O. I.	38	++	8	++	−
I. S.	10	++		+	−
M. W.	28	++		+	−
M. N.	17	++		+	−
L. A.	10	++		+	−
B. L.	14	+		+	++ (Tibia)
J. B.	10	+		+	−
J. R.	16	+		+	−
C. H.	14	+	7	+	−
R. B.	18	+		−	−
J. F.	10	+		−	−
M. R.	17	+		−	−
D. C.	17	−		−	−
E. W.	14	−		−	−
M. H.	39	−	4	−	−
A. M.	28	−		−	−

Clinical Observations: Examination of the mouth revealed no significant changes. The oral mucosa, tongue, and pharynx appeared normal in the 22 patients with sickle-cell anemia. The teeth were well developed and firmly attached. The gingivae also appeared normal.

DISCUSSION

Pathologic Process: Sickle-cell anemia is considered to be the result of a congenital anomaly of that portion of the hematopoietic system concerned with the development of erythrocytes. The abnormal cells that are produced act as foreign bodies and are destroyed prematurely by the reticuloendothelial system, causing an anemia of varying degree. The bone marrow responds to overcome the anemia by increased production of red cells, becomes hyperplastic, and expands. This compensatory expansion progresses at the expense of bone and produces secondary changes in the skeletal system which have been observed roentgenographically.

Roentgen Changes in the Skeleton: The bone changes occur without external enlargement except in the case of the parietal bone. Changes in the roentgenograms are found within the cortical outlines of the bone. This indicates that the process is intra-osseous. The effects of the excessive and abnormal growth activity of the marrow is maximal in the bones which are normally engaged in blood cell formation, such as the skull and cancellous bones of the trunk. In these bones, osteoporosis is dominant. In that part of the long bones where there is usually no hematopoiesis, sclerosis predominates. In the most distal bones of the hands and feet the changes appear to be minimal. It would seem from the above description that the bone marrow is primarily affected and that the bone changes are secondary, being a result of hyperplasia of the marrow secondary to a severe degree of hemolysis, congestion, thrombosis, infarction, scarring, and regeneration of the bone.

These factors may explain the conflicting reports that have appeared in the literature regarding changes in the long bones. The hyperplasia of the erythroblastic elements causes pressure upon the adjacent bone, which becomes resorbed and produces the following results: (*a*) irregular trabeculation; (*b*) widening of the medullary spaces; (*c*) cortical thinning. The changes due to thrombosis, on the other hand, may result in (*a*) cortical thickening and (*b*) narrowing of the medullary cavity.

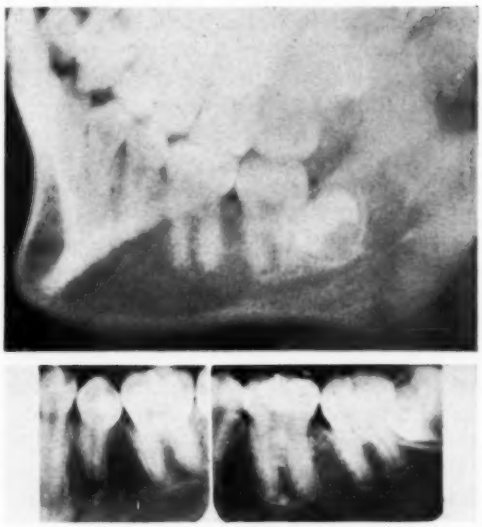


Fig. 5. Lateral and dental roentgenograms of corresponding areas in the mandible in a patient with sickle-cell anemia. Note the greater detail of the bone pattern in the dental roentgenograms. The osteoporosis was classified as of moderate degree.

Some investigators feel that in some cases it is possible to make a tentative diagnosis of sickle-cell anemia by roentgenographic examination, although the diagnosis has not been suspected clinically. Carroll and Evans (1) reported that in 20 of 37 patients in whom roentgenographic examinations of the long bones were made, the findings indicated some abnormal change. Roentgenograms of the spine were obtained in 39 of their patients, and 28 of these showed osteoporosis and increased prominence of the trabeculae.

Roentgen Changes in the Jaws: Since, like the rest of the bony structures of the body, the mandible and maxillae may play a role in hematopoiesis, it was reasonable

to expect these bones also to reflect a generalized disturbance of the bone marrow. It is well known, moreover, that phosphorus, radium, and mercury poisoning are frequently manifested earlier in the jaws than in other bones of the body (16).

The diffuse osteoporosis of the jaws observed in this series of cases is probably due to a general disturbance of the marrow, which becomes hyperplastic and expands, causing a resorption of medullary bone. This is manifest in the roentgenogram by an increased porosity. In addition, the osteoporosis in the dental roentgenogram may be due to a reduction in the thickness of the compact layer of bone. This thinning of the compact bone also results in a more prominent visualization of the remaining trabeculae. The compact bone (lamina dura) which surrounds the roots of the teeth usually appears to be prominent and intact (Figs. 1A, 2A, 3). Clinically, the mobility of the teeth was within the normal range.

Value of Dental Roentgenograms in Sickle-Cell Anemia Studies: The dental roentgenogram offers a detailed view of bone structure (Fig. 5). The film is placed in close apposition to the jaw bone with only a thin mucous membrane interposed. In this way, fine bone detail is brought into sharp focus and is well visualized. Similar detail is not achieved in roentgenograms of the long bones, not only because of the large area being examined but also because of the varying thickness of the surrounding soft tissue. For similar reasons roentgenograms of the skull do not show as much detail.

SUMMARY AND CONCLUSIONS

1. Roentgen studies of the jaws were made in 22 patients with proved sickle-cell anemia. Significant findings, characterized by a generalized osteoporosis, were found in the dental roentgenograms of 18 of this group. Significant findings were observed in the roentgenograms of the long bones of 3 patients and of the skull in only 1 patient.

2. Since sickle-cell anemia is a systemic disease, dental roentgenograms should be taken in addition to those of the long bones and skull.

3. Although an unusual degree of osteoporosis as shown in the dental roentgenogram may not necessarily be pathognomonic for sickle-cell anemia, it should be given consideration in the differential diagnosis.

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SUMARIO

Estudios Roentgenológicos de los Maxilares en la Drepanocitemia

Las radiografías dentarias de 22 negros de varias edades, en que se había establecido el diagnóstico de anemia por células falciformes, fueron estudiadas en busca de posibles alteraciones radiográficas en las mandíbulas, descubriéndose 18 alteraciones significativas en forma de osteoporosis generalizada. El número de trabéculas óseas había disminuído, y las restantes estaban netamente demarcadas y rodeadas de espacios de médula ósea, de forma irregular. Sólo 4 enfermos de la serie mostraron importantes alteraciones en el cráneo y los huesos largos.

Como la película dentaria se coloca en íntima aposición al hueso maxilar, sin más interposición que una delgada mucosa, quedan en foco agudo los delicados detalles de los huesos y se visualizan en forma que no es posible en los huesos del cráneo y de los miembros. Están, pues, indicadas las radiografías dentarias, así como las de otros tejidos óseos, para el diagnóstico de la drepanocitemia. Aunque una osteoporosis inusitada descubierta de ese modo quizás no sea forzosamente patognomónica de dicha anemia, hay que considerarla en el diagnóstico diferencial.

Cholecystography with Telepaque

A Preliminary Report[1]

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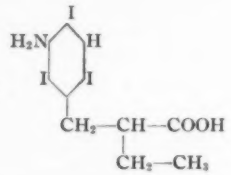
TELEPAQUE,[2] a new cholecystographic medium, is an iodine substituted organic compound, containing 66.68 per cent iodine as compared with 51.38 per cent in the cholecystographic medium now widely used. The chemical formula is: 3-(3-amino-2,4,6-triiodophenyl)-2-ethyl-propanoic acid.



Telepaque is supplied in 0.5-gram tablets which are about the size of aspirin tablets and easily swallowed. Experimental studies in animals have demonstrated a wide margin of safety in the doses used to opacify the gallbladder (1).

To evaluate the clinical usefulness of the new agent, it was given to a consecutive series of patients who had been referred, because of symptoms, for roentgen study of the gallbladder. The telepaque tablets were issued by the Drug Department of the University of Minnesota Hospitals with no attempt at selection of cases. For the first series (83 cases), six tablets (3.0 grams) were given to each patient. Concurrently, a control series of cases was recorded using the cholecystographic medium now in common use, beta-(4-hydroxy-3,5 diiodophenyl)-alpha-phenyl-propionic acid. Instructions for use of the two agents were identical except that the patients receiving telepaque were requested to take the tablets ten hours before reporting for radiographic examination, while those in the control series took theirs fourteen hours before examination. When the patient reported to the X-ray Department he was questioned directly concerning any symptoms developing after taking the cholecystographic agent. Any symptom mentioned by the patient, regardless of its mildness or severity, was recorded as a reaction.

A 14 × 17-inch film of the abdomen was first obtained to evaluate any residual opaque material in the bowel. Following this, routine cholecystograms were made in the usual positions.

In each case the density of the cholecystogram was recorded as a numerical value, according to the scoring scheme devised by Hoppe (3), as indicated below.

Cholecystographic Index	Description
4	Excellent: A sharp outline of the gallbladder with sufficient intensity to make the gallbladder stand out in brilliant contrast with the surrounding tissues
3	Good: A distinct shadow of the gallbladder with satisfactory intensity and good definition
2	Fair: A faint shadow of the gallbladder with faint but visible definition
1	Poor: Faint evidence of gallbladder concentration as shown by an area of increased density in the region of the gallbladder, but with no definition

RESULTS

The initial group of 83 patients received a dose of 3.0 grams, comparable in weight to the control medium. In 27.7 per cent

[1] From the Department of Radiology and Physical Medicine, University of Minnesota Medical School, Minneapolis 14, Minn. Accepted for publication in January 1952.
[2] The telepaque for this study was furnished by Winthrop-Stearns, Inc., 1450 Broadway, New York, N. Y.

of the patients who received this dose of six tablets undesirable reactions occurred, while the incidence in the control group was 34 per cent. These reactions were felt to be minor in nature and none would seem to present a contraindication to cholecystography, regardless of which agent was used. Dysuria, which occasionally occurs with the control medium, would not be expected with telepaque, as it has been shown experimentally to be eliminated almost entirely through the gastro-intestinal tract, and it was not observed in this series.

Fig. 1A. Roentgenogram of the abdomen ten hours after ingestion of 3.0 grams of telepaque, showing gallbladder shadow of average density. Small non-opaque calculi are evident. The amount and character of the residual opaque material in the colon are also representative.

The density of the gallbladder shadow was considerably greater in the patients given telepaque than in the control group (Fig. 1). The results in this regard are summarized in Table I (item 5). Furthermore, the percentage of cases with identifiable positive shadows was somewhat greater with telepaque.

Fig. 1B. Roentgenogram of the gallbladder in case shown in Fig. 1A forty-five minutes *post-cibum*. The small calculi are now well demonstrated (lower arrow) and the cystic and common bile ducts are visualized (upper arrow), as was true in many of the telepaque cholecystograms. Note the opaque material in the colon overlapping the gallbladder (lateral arrow).

In occasional cases it was possible to obtain a satisfactory gallbladder shadow with telepaque when no shadow could be observed after using other cholecystographic agents. Accordingly, 10 patients were given both the control agent and six tablets of telepaque at different examinations. In 5 cases the gallbladder was not visualized with either medium and in 3 cases it was visualized with both. In 2 cases a definite gallbladder shadow was obtained with telepaque but not with the control agent. Figure 2 shows three cholecystograms of the same patient. In the first two examinations, made with six tablets of telepaque, the gallbladder could be visualized, along with a portion of the cystic and common bile ducts. In the third examination, made at a later date, with the control medium, the gallbladder was not visualized. Scott and Simril (4) have also obtained diagnostic cholecystograms with telepaque while another cholecystographic agent failed to opacify the gallbladder in the same patient.

Fig. 2A. Cholecystogram made Jan. 22, 1951, using 3.0 grams of telepaque. The gallbladder is visualized along with portions of the cystic and common bile ducts. There is a small amount of opaque material still in the colon.

B. Cholecystogram made Jan. 29, 1951, using 3.0 grams of telepaque, with the same results as in A.

C. Film of the gallbladder area fourteen hours after ingestion of the control medium. There is no evidence of a gallbladder shadow.

Christensen and Sosman (2) noted that the cystic and common bile ducts could often be seen on the *post-cibum* films when telepaque was used. This was also true in our cases, as demonstrated by Figure 1B.

The greater opacity of the gallbladder obtained with telepaque did not appear to make the identification of non-opaque calculi any more difficult. The percentage of cases in which calculi were observed was roughly the same as in the control series. The appearance of calculi in the telepaque cholecystogram is illustrated in Figures 1 and 3, and the contrast appears to be entirely satisfactory.

All of the telepaque cholecystograms were made ten hours after ingestion of the material, but Scott and Simril (4) have demonstrated a satisfactory gallbladder shadow in an obese patient after an interval of only four hours.

Residual opaque material in the colon was a common finding, observed in 80.7 per cent of the patients who had received this new medium (Figs. 1A and 3). In no case, however, did it interfere with adequate demonstration of the gallbladder. A similar observation has been recorded by Christensen and Sosman (2). Since the opacity of the gallbladder shadow with 3.0 grams was rather high, it was thought that smaller doses might give good shadows and reduce the amount of residual opaque medium in the colon. A group of 31 patients were given three tablets (1.5 grams) of telepaque, the remainder of the procedure

being similar. The average cholecystographic index in this group was 2.6 (compared with 3.4 when six tablets were used), and the incidence of residual opacity in the bowel decreased to 51.6 per cent. Two patients received four tablets (2 grams) (Fig. 4). The results of these two series

Fig. 3. Telepaque cholecystogram showing satisfactory visualization of non-opaque calculi. There is also residual telepaque in the colon.

Fig. 4. Roentgenogram of the abdomen ten hours after ingestion of 1.5 grams of telepaque, showing typical gallbladder density and residual opacity in the colon with the three tablet dose.

are summarized in Table I (item 5). The advantages obtained from the diminished amount of medium in the colon were insufficient to justify using the smaller dose consistently.

CONCLUSIONS

Telepaque is an acceptable cholecystographic medium giving a somewhat lower

TABLE I: CHOLECYSTOGRAPHY WITH TELEPAQUE

1. Medium →	Control	Telepaque		
		3 grams	2 grams	1.5 grams
2. Number of cases	100	83	2	31
3. Per cent of patients showing undesirable symptoms*	34	27.7	0	29
(*a*) Dryness of throat or mouth	3	1.2	0	9.7
(*b*) Nausea	12	12	0	9.7
(*c*) Vomiting	4	0	0	0
(*d*) Diarrhea	15	9.6	0	6.4
(*e*) Dysuria	1	0	0	0
(*f*) Headache	3	2.4	0	9.7
(*g*) Faintness	1	0	0	3.2
(*h*) "Heartburn"	2	2.4	0	0
(*i*) Cramps	2	1.2	0	0
(*j*) "Dizziness"	1	2.4	0	3.2
4. Residual opacity in the gastro-intestinal tract	14	80.7	50	51.6
5. Cholecystographic index (mean)	2.8	3.4	4	2.6
6. Not visualized	17	20.4	0	9.7
7. Calculi	15	14.4	50	6.4

* Some patients presented more than one symptom.

incidence of minor untoward symptoms than other media used for this purpose. When it is used in doses of 3 grams, the average density of the gallbladder shadow is appreciably greater than with 3 grams of the control medium. It is often possible to visualize the cystic and common bile ducts following use of telepaque and thus gain additional information about the biliary structures. In some cases it is possible to obtain a gallbladder shadow with telepaque but not with the control medium. A possible disadvantage is the large number of cases showing opaque material in the colon after ingestion of telepaque, although in this series of patients the opacity never interfered with satisfactory interpretation of the films. The use of smaller doses, 1.5 grams of telepaque, does not seem to offer any real advantages over the full 3.0-gram dose. The smaller amount leaves less residue in the colon, but the average cholecystographic index is lower and there is no appreciable difference in the incidence of undesirable reactions.

ADDENDUM: After the submission of this paper for publication, there appeared in Radiology (**58:** 231, February 1952) a study of telepaque as a cholecystographic medium, by Morgan and Stewart.

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SUMARIO

Colecistografía con Telepaque. Comunicación Preliminar

En una serie de 83 casos enviados para que se les ejecutara la colecistografía, se descubrió que Telepaque, nuevo medio colecistográfico que contiene 66.68 por ciento de yodo, provocaba una incidencia algo menor de síntomas contraproducentes de menor cuantía que otros medios usados para dicho fin. Cuando se usaba el nuevo medio a dosis de 3.0 gramos, el espesor medio de la imagen de la vesícula biliar resultó apreciablemente mayor que con 3.0 gramos de un medio testigo, y se obtuvo visualización en algunos casos en que el medio testigo no había revelado la vesícula. Un residuo de substancia opaca en el colon fué hallazgo frecuente, pero esto no impidió la interpretación satisfactoria de las radiografías.

Roentgen Manifestations of Lymphosarcoma of the Stomach[1]

PAUL H. DEEB, M.D., and WALTER L. STILSON, M.D.

LYMPHOSARCOMA as a generalized process is well known. Focal lymphosarcoma is less familiar, but is being found increasingly. Ackerman and del Regato (1), in their textbook on cancer, write: "Lymphosarcoma is often seen first as a generalized process, but a certain unknown but *increasing* proportion of cases has been reported with a definite focus of origin. Regato in 1939 reported that lymphosarcoma frequently arose from the region of Waldeyer's ring (nasopharynx, tonsil, base of the tongue). The second-most common location is from the gastro-intestinal tract, from the stomach, large bowel or small bowel." Sugarbaker and Craver (8), reviewing 196 proved cases of lymphosarcoma, found that 5.5 per cent arose in the digestive tract, and that over half of these had their origin in the stomach. In their series one-third of the cases appeared to originate outside the lymphatic system.

INCIDENCE

The latest comprehensive review of lymphosarcoma of the stomach is that of Archer and Cooper (2) in 1939. They stated that up to 1937 Taylor had collected 152 cases of primary lymphosarcoma of the stomach. As a result of a questionnaire to radiologists and institutions, they added to these 94 cases including 3 of their own. Since that time there have been a few sporadic reports of primary lymphosarcoma of the stomach, so that the cases in the literature now probably number about 250. It is our opinion that the incidence of this disease is higher than has previously been thought. Of 250 patients admitted to the surgical service of the Mt. Sinai Hospital (New York) from 1937 to 1943 in whom the diagnosis of neoplasm of the stomach was made, 8 were found to have lymphosarcoma, an incidence of 3.2 per cent (10). Seven of these were small round-cell lymphosarcomas and one was a reticulum-cell sarcoma. This low incidence of reticulum-cell sarcoma of the stomach is borne out by others. Cash and Rappoport (5) mention its rarity and report one case.

ROENTGEN MANIFESTATIONS

There is some disagreement as to the roentgen manifestations of lymphosarcoma of the stomach. Yarnis and Colp (10) felt that gastric lymphosarcoma occurs in two forms, grossly: in one the cells infiltrate diffusely, causing apparent simple hypertrophy of the rugae, while in the other there is definite tumor formation, often with ulceration. The first form is frequently overlooked surgically, since the stomach not only appears normal externally but is quite normal to palpation. The second type is quite indistinguishable grossly from carcinoma. These writers are not sure that giant rugae play an important part in the roentgen diagnosis of lymphosarcoma of the stomach. They believe that gastroscopy may be of definite value in identifying the diffusely infiltrating type with numerous submucous tumors.

McSwain and Beal (6) suggest that the large size of the lesion in relation to the duration of symptoms and the presence of whorl-like defects in the barium outline of the stomach are indicative of lymphosarcoma. Taylor (9) has stated that the lesions do not show early ulceration. In the series of cases collected by Archer and Cooper, 27 showed ulceration; in 19 there was tumefaction in addition, while 28 showed tumefaction alone. These authors felt that there was nothing characteristic about either the ulcer or the tumor except that in one of their patients a very large ulcer with a short history in an adolescent

[1] From the Department of Radiology, College of Medical Evangelists and White Memorial Hospital, Los Angeles, Calif. Accepted for publication in September 1951. Case records brought up to date in proofs.

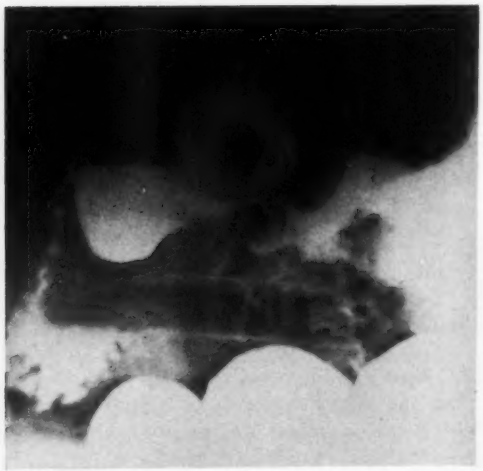


Fig. 1. Case I: Lymphosarcoma of the stomach. Pressure spot film of prepyloric area showing coarse, irregular rugal pattern. The area was relatively flexible as observed fluoroscopically.

made them suspicious of lymphosarcoma. They do not feel that large rugae are important. However, in the case of reticulum-cell sarcoma reported by Cash and Rappoport, large rugae proximal to the filling defect were important. Furthermore, Benedict (3), in discussing diseases of the stomach correlated radiologically, gastroscopically, and pathologically, felt that the gastroscopic diagnostic criteria for lymphoma would be unusually thick rugae, very marked cobblestone mucosa, multiple erosions, and ulcerations of various parts of the stomach with or without rigidity or a tumor. He described five cases of proved lymphoma. Three of these had findings typical of carcinoma. In one marked swelling of the folds was demonstrated.

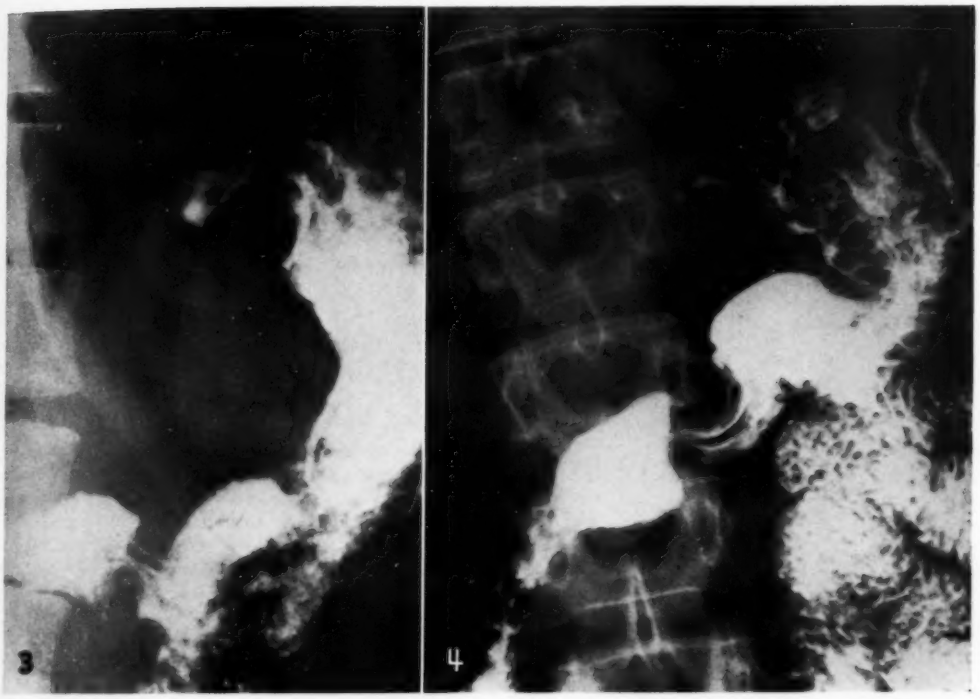
Cardon and Greenebaum (4) felt that the diagnosis of lymphosarcoma of the stomach was difficult for the following reasons: (1) the disease is rare; (2) it mimics carcinoma or ulcer completely in the majority of cases; (3) the differential features seldom appear; (4) some of these differential features occur also in atypical carcinoma, gastritis, syphilis, and other diseases of the stomach; (5) suggestive features may not occur until late in the disease. These writers reported one case of proved lymphosarcoma of the stomach with a duration of four years. In this instance they believed that the long duration without cachexia, prolonged septic fever, splenomegaly, and late appearance of occult blood in the stool should have led to a suspicion of lymphoblastoma of the stomach.

Fig. 2. Case I: Lymphosarcoma of the stomach. The neoplastic defects seen in Fig. 1 have completely disappeared from both the cardia and the prepyloric area following x-ray therapy. Prepyloric narrowing persists.

The repeated roentgen findings, however, were always interpreted as carcinoma.

CASE STUDIES

CASE I: O. L., white female, age 37, was first seen at the White Memorial Clinic on Nov. 22, 1944, complaining of gastric distress for seven years. Roentgen examination elsewhere seven years earlier was thought to indicate duodenal spasm, and the pain was relieved by taking food. Since that time the patient had had two attacks of severe pain with vomiting. There was no history of tarry stools. Physical examination at entry was negative except for tenderness in the epigastrium with considerable guarding. No masses were palpable. At the first radiological examination the patient was thought



Figs. 3 and 4. Case II: Lymphosarcoma of the stomach. The initial examination (Fig. 3) shows a rounded, fairly smooth defect high on the lesser curvature. Another film on this same date showed an ulcer in this defect. Three months after beginning x-ray therapy (Fig. 4) both defect and ulcer had disappeared.

to have a prepyloric hypertrophic gastritis, and the repeat examination suggested a carcinoma.

Gastroscopic examination was advised by the radiologist and performed by Dr. Olov Blomquist, who found the pyloric end of the stomach to be funnel-like, rigid, and thickened. Several polypi were found and the mucosa was granular, and even nodular. "*Gastroscopic impression:* Probable infiltrating carcinoma of the pyloric end of the stomach. It is impossible to distinguish the gastric lesions from severe hypertrophic gastritis or even lymphosarcoma." The gastroscopic examination was repeated eleven days later by Dr. Rudolph Schindler, who thought that the patient had either multiple adenomatous polyps or hypertrophic gastritis with pseudo-polyps.

Exploratory laparotomy on Feb. 16, 1945, by Dr. Jacob Janzen, revealed an irregular, nodular, thickened area near the pylorus. Exploration of the interior of the stomach disclosed areas of a soft, lymphoid type of tissue showing ulceration and hemorrhage. A similar area was found high in the fundus. Several lymph nodes were palpable. Biopsy of the stomach and of the lymph nodes revealed small-cell lymphosarcoma in both sites.

Postoperatively radiation therapy was given through four portals directed toward the stomach. Within four months the patient received an estimated 3,500 r to the tumor and one year later approximately an additional 1,200 r. Her last treatment was on Oct. 26, 1947. She was last seen in February 1951, at which time gastroscopic examination indicated no evidence of tumor.

The roentgen examination (Fig. 1) revealed very heavy, coarse, irregular rugae in the prepyloric area, with little loss of flexibility. An additional film (Fig. 2) after therapy indicated disappearance of these findings, though flexible narrowing of the prepyloric area persisted.

CASE II: V. T., male, age 30, was seen at the White Memorial Clinic in October 1946 with a history of epigastric distress for eighteen months. He had had similar distress five years before, which quickly improved. He had had one episode of hematemesis three weeks prior to admission. Gastroscopic examination by Dr. Olov Blomquist showed evidence of a lesion just inside the cardia on the lesser curvature of the stomach, suggesting "possible carcinoma, possible lymphoma, possible healing ulcer." A repeat gastroscopic examination was more suggestive of lymphosarcoma. Radiological study also suggested lymphosarcoma. Dr. Jacob Janzen, on exploration, could find no lesion in

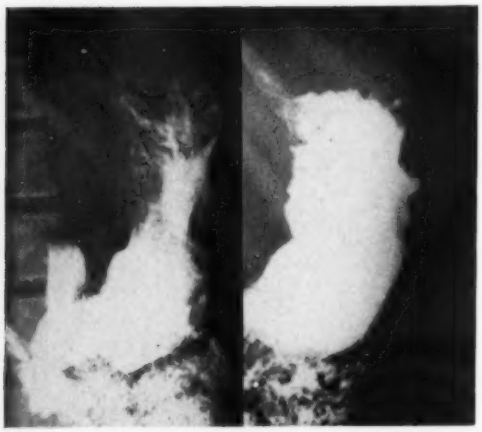
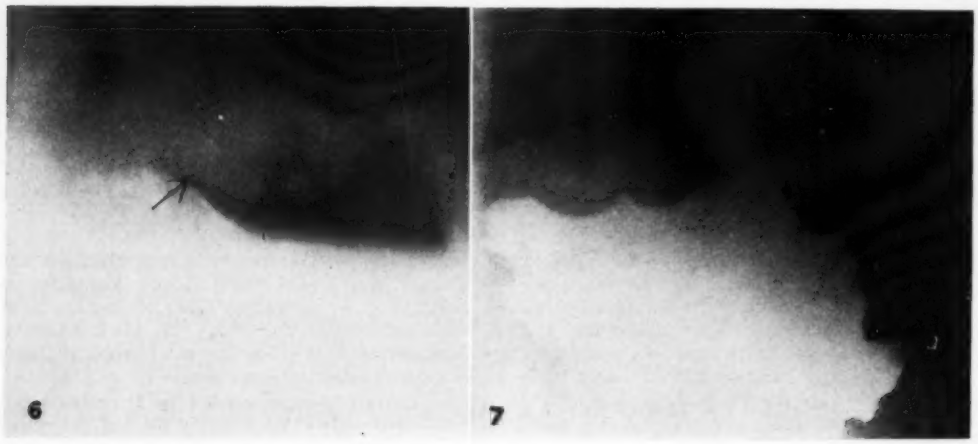


Fig. 5. Case III: Lymphosarcoma of the stomach. The illustration to the right shows a defect with central ulceration high on the greater curvature. The irregular rugae are seen on the view to the left.

coma. Roentgen examination made following treatment indicated disappearance of the tumor (Fig. 4), and on the last examination, May 8, 1950, there was no evidence of tumor in the stomach.

CASE III: S. T., female, age 33, was referred to the White Memorial Clinic for a gastroscopic examination in November 1949. In the past six weeks she had experienced severe upper left quadrant pain, alternate diarrhea and constipation, and a weight loss of 13 pounds. A radiological examination done elsewhere was reported as negative. There were no masses palpable and no abdominal tenderness. Gastroscopic examination by Dr. Olov Blomquist revealed an ulcer 1.4 cm. in diameter, at least 1 cm. deep, on the posterior wall near the greater curvature, which he felt was malignant. Radiological examination confirmed the presence of the ulcer. On recheck gastroscopy, a month later, there remained a crater 12 to 15 mm. in diameter, 8 to 10 mm. deep, in the area where the large ulcer had previously been seen. Dr. Blomquist felt that lymphoma was to be strongly suggested. On



Figs. 6 and 7. Case IV: Gastric manifestations of generalized lymphosarcoma. In Fig. 6 the masses of tumor are seen projecting into the air bubble of the stomach from above. With barium in the cardia of the stomach (Fig. 7) the irregularity of the cardia, suggesting very large rugae, is seen.

the stomach. On insistence by the gastroscopist, however, a strip of stomach was excised for biopsy purposes. The pathological report was small-cell lymphosarcoma. The patient was given radiation therapy in January, February, and March of 1947 and has remained well. He was last heard from on March 28, 1951, at which time he was working hard at manual labor.

The roentgen findings were as follows: The initial examination (Fig. 3) revealed a smooth 2-cm. filling defect with a suggestion of a fleck on the lesser curvature of the cardiac end of the stomach which might represent a benign extramucosal tumor. On recheck examination the radiologist suggested lymphosar-

Dec. 11, 1949, exploration revealed an indurated area on the greater curvature of the stomach attached to the tissue of the splenic pedicle. There were numerous large, soft lymph nodes in the omentum and around the celiac axis. The operative impression was benign gastric ulcer. A pathological report on the subtotally resected stomach was lymphocytic lymphosarcoma. In January and February of 1950 radiation therapy was given. Gastroscopic examination on Jan. 26, 1951, revealed no evidence of lymphoma. Roentgen studies a year later (February 1952) also failed to show recurrence.

Radiological examination in this case (Fig. 5) dis-

closed a large, penetrating gastric ulcer on the greater curvature near the cardia. Recheck about three weeks later indicated in addition considerable irregularity of the mucosa and irregularity of the rugal folds in the cardia.

CASE IV: R. P., male, age 51. This case is not reported in detail because it was one of generalized lymphosarcoma, though there were roentgen findings in the stomach. At the cardiac end tumor masses were seen projecting into the gas bubble (Fig. 6). The barium outlining the proximal portion of the stomach shows an irregular filling defect and the rugal pattern is exceedingly coarse and irregular (Fig. 7). These defects were completely obliterated by radiation therapy as seen in the follow-up films (Fig. 8).

CASE V: E. K., female, age 80. This case is included because of the roentgen findings in the stomach—a very large mass displacing the stomach anteriorly, with a large ulcer on the posterior wall of the cardiac end (Fig. 9). This is another case of generalized lymphosarcoma, arising in the tonsil.

Fig. 8. Case IV: Gastric manifestations of generalized lymphosarcoma. Disappearance of masses and coarsening of the rugal folds two weeks after x-ray therapy.

CASE VI: W. H., male, age 72. This case is included not because it is primarily a lymphosarcoma of the stomach, but because the roentgen findings are similar to those in the above cases. This man had cervical adenitis on the left side which regressed rapidly under x-ray therapy, but lymphosarcoma was not proved by biopsy. There can be seen at the cardiac end a mass displacing the stomach from the diaphragm and producing finger-print-like deformities in the upper portion of the barium outline (Fig. 10). Small intestinal changes were also present.

Fig. 9. Case V: Gastric manifestations in generalized lymphosarcoma. This patient with generalized lymphosarcoma had a large ulcer on the posterior wall of the stomach extending into a mass which displaced the stomach anteriorly.

COMMENT

The foregoing case studies illustrate the several roentgen manifestations of lymphosarcoma of the stomach described by other investigators. Case I was indistinguishable at first from carcinoma, though hypertrophic gastritis was also suggested. In Case II the primary feature was tumefaction, and in Case III ulcer. In most of the cases the gastric rugae in the involved area were coarse and irregular. In most, the defect was somewhat more flexible, as seen fluoroscopically, than is usual for carcinoma.

In these cases the gastroscopist has been of considerable aid. In the three cases primary in the stomach, the diagnosis was first suggested by him. In one case the lesion was so small as to escape the observation of the surgeon.

It is of interest to note that two of the

Fig. 10. Case VI: Gastric manifestations in a case of probable generalized lymphosarcoma. The findings in this case are similar to those of Case IV. A tumor at the cardia produced a filling defect with irregular outline and with widening of the space between the barium in the cardia and the diaphragm.

three patients in whom the stomach was the primary focus are known to be alive and well for seven and four and a half years, respectively, after diagnosis. The third patient is alive and well two years after treatment.

SUMMARY AND CONCLUSIONS

1. Lymphosarcoma of extra-nodal origin is of relatively frequent occurrence.

2. The incidence of lymphosarcoma as a primary process in the stomach is not inconsiderable, and the condition should be more frequently thought of in differential diagnosis.

3. The roentgen manifestations of this disease have been reviewed. The differentiation roentgenologically from carcinoma or even ulcer remains difficult.

4. The presence of a relatively flexible deformity and coarse, irregular rugae suggests lymphosarcoma.

5. Close cooperation between the radiologist and the gastroscopist results in a much higher degree of accuracy of diagnosis.

6. Long freedom from symptoms after radiation therapy in two cases of lymphosarcoma of the stomach has been reported.

NOTE: We are indebted to Mr. Edward Hamilton, of the Department of Visual Education, for the photographic reproductions, and to Mrs. Eunice Shreve for help in preparation of the manuscript.

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SUMARIO

Manifestaciones Roentgenológicas del Linfosarcoma Gástrico

Llámase la atención sobre la frecuencia del linfosarcoma de origen extraganglionar, es decir, fuera del sistema linfático. Comunicados ya unos 250 casos de linfosarcoma del estómago, parece que el estado alcanza suficiente incidencia para merecer consideración más frecuente en el diagnóstico diferencial.

Las manifestaciones roentgenológicas son muy indicativas de carcinoma y la diferenciación de ambos estados resulta difícil radiológicamente. La presencia de una deformidad relativamente flexible y de arrugas irregulares y groseras milita en pro del linfosarcoma. La íntima colaboración entre el radiólogo y el gastroscopista da por resultado una exactitud mucho mayor en el diagnóstico.

Descríbense 3 casos de linfosarcoma de células pequeñas comprobado, primario del estómago. Los 3 enfermos se hallaban vivos y sanos a los siete años, cuatro años medio y dos años, respectivamente, de la radioterapia. También se presentan 2 casos de linfosarcoma generalizado con lesiones en el estómago.

Emergency Diagnosis of Upper Digestive Tract Bleeding by Roentgen Examination Without Palpation ("Hampton Technic")

HARVEY C. KNOWLES, M.D., BENJAMIN FELSON, M.D., NATHAN SHAPIRO, M.D., and LEON SCHIFF, M.D.

GROSS HEMORRHAGE from the upper digestive tract is a serious and dramatic event. The early recognition of the cause and site of bleeding determines the treatment and may be lifesaving. While the source of the hemorrhage can often be suspected from the history and physical findings, the patient's condition may preclude adequate interrogation or examination. Hemorrhage may occur without symptoms which might offer a clue as to its cause. Moreover, even with a clear-cut peptic ulcer history, it is helpful to know whether the ulcer is gastric or duodenal, since gastric ulcers usually bleed more severely and are more likely to require emergency surgical intervention (1, 2, 14).

Recent advances in the medical and surgical management of patients with hemorrhage from esophageal varices (10, 11, 12) and peptic ulcer (8, 9, 15) make it imperative that the source of bleeding be determined during the *acute* episode. A knowledge of the exact location of the lesion will also be of great help to the surgeon if operation becomes necessary.

It is apparent, then, that early roentgen examination in upper digestive tract bleeding merits serious consideration and might serve at least three purposes: (1) as a means of determining the source of hemorrhage for definitive treatment, (2) as a help in selecting the surgical approach should emergency operation prove necessary, and (3) as an index of prognosis.

In 1937, Hampton (6) described the use of early roentgen study without palpation in acute bleeding from the upper digestive tract. Few reports concerning evaluation of this method of examination are encountered in the literature (3, 4, 6, 13, 15). Although our experience with the procedure at the Cincinnati General Hospital dates back to 1938, the present report is based only on cases seen between July 1, 1949, and July 1, 1950. This period was selected because all the patients were personally observed by one of us (H. C. K.) and could be studied under uniform circumstances.

TECHNIC

The gastro-intestinal roentgen examinations are performed as emergency procedures by residents in radiology, who are instructed to avoid palpation and pressure of any sort. The examinations are made with a 200-ma., 100-kv. x-ray unit equipped with spot-film device and rotating anode tubes above and below the table. A 6-ounce mixture of barium sulfate and water in equal volumes is used. The procedure, which we call the "Hampton technic," is as follows:

The patient is lifted from stretcher or bed to x-ray table in supine position by means of a draw sheet. About 2 ounces of the barium mixture is given, and the patient is turned on his right side, then back to the supine position. This serves to distribute the barium over the wall of the entire stomach. Multiple non-pressure spot films of the stomach are then obtained. Next, the patient is again placed on his right side until barium is seen to enter the duodenal bulb, after which he is returned to the supine position and rotated toward the left (the Hampton maneuver). In this position the gas bubble rises into the antrum and bulb, producing a double-contrast effect. By varying the degree of rotation, the bulb can usually be projected to the left of the spine free

[1] From the Department of Radiology and the Gastric Laboratory of the Department of Medicine, University of Cincinnati College of Medicine and the Cincinnati General Hospital. Accepted for publication in September 1951.

TABLE I: ACCURACY OF DIAGNOSIS BY THE HAMPTON METHOD

Final Diagnosis	Number of Cases	Final Diagnosis Established by				Diagnosis by Hampton Method		
		G.I. Series with Palpation	Operation	Autopsy	Clinical Course	Correct	Incorrect	Unsatisfactory
Duodenal ulcer	41	25	14	2	0	35	4	2
Gastric ulcer	12*	1	8	3	0	8	3	1
Gastric carcinoma	3	0	3	0	0	3	0	0
Esophageal varices	8	2	3	1	2	6	2	0
Miscellaneous	2	0	0	0	2	2	0	0
TOTALS	66†	28	28	6	4	54(86%)	9	3

* Includes 1 case of marginal ulcer and 2 cases of ulcer in hiatal hernia.
† In 17 cases a final diagnosis was not established. In each of 3 cases 2 diagnoses were made.

from other barium shadows, and appropriate spot films can be obtained. The patient is then placed in the prone position with the left side elevated, and additional spot films of the stomach and the duodenum are made. At this point the remainder of the barium is given and the filled stomach and duodenum are again studied. Further spot films are made as indicated. Next, the esophagus is examined with a thick barium mixture and spot films are obtained. Bucky right lateral and right anterior oblique films complete the examination. The entire procedure requires approximately thirty minutes.

Variations from the above procedure are often dictated by the condition of the patient and by the nature and location of the lesion. In some instances the roentgen examination was performed while transfusion was in process. Following the fluoroscopic examination, the wet films are studied by the resident and often by the staff roentgenologist, and an oral report is made. Repeat examinations are performed as indicated; they proved necessary in six cases in the period covered by this study.

MATERIAL

During the year July 1, 1949, to July 1, 1950, 100 patients were admitted to the Medical Service for acute upper gastro-intestinal bleeding. Of the 100 cases, 80 were studied by the Hampton technic. The remaining 20 cases were not examined, either because of irreversible shock or because a recent gastro-intestinal examination demonstrating the probable source of the hemorrhage had been made. The patient was sent directly from the admitting ward to the X-ray Department if his condition permitted. In many cases, however, the roentgen examination was delayed from six to twenty-four hours while the patient received transfusions and other supportive care on the medical ward.

The ages of the 80 patients ranged from seventeen to seventy-two years. The final diagnoses established in these cases are listed in Table I. In 17 of the 80 cases a diagnosis was not established. In the remaining 63 cases, 66 significant lesions were recorded, of which 34 were proved by operation or autopsy, 28 appeared obvious on follow-up gastro-intestinal examination with palpation, and 4 seemed certain from the clinical course. The latter 4 cases included 2 instances of cirrhosis of the liver proved by biopsy, in one of which the bleeding was controlled by a Patton balloon tube (10), 1 case of Schönlein-Henoch's purpura with bleeding into the skin, meninges, and gastro-intestinal tract, and 1 of bleeding gums and hematemesis resulting from prothrombin deficiency.

The 17 cases in which a final diagnosis could not be established included 4 cases in which both the Hampton and the follow-up gastro-intestinal series with palpation showed no abnormalities, 4 cases in which the two methods disagreed and a definite conclusion could not be reached, and 9 cases in which only a Hampton procedure

TABLE II: ERRORS IN DIAGNOSIS BY THE HAMPTON METHOD

Case	Diagnosis by Hampton Technic	Diagnosis by Regular G.I. Series	Final Diagnosis	Established by
1	Normal	Duodenal ulcer	Duodenal ulcer	Regular G.I. series
2	Normal	Duodenal ulcer	Duodenal ulcer	Operation
3	Normal	Not done	Duodenal ulcer	Operation
4	Normal	Not done	Duodenal ulcer	Autopsy
5	Duodenal ulcer	Not done	Duodenal and gastric ulcer	Operation
6	Complete pyloric obstruction	Duodenal ulcer	Duodenal and gastric ulcer	Operation
7	Large hiatal hernia	Large hiatal hernia	Hiatal hernia; esophageal ulcer	Autopsy
8	Hiatal hernia with short esophagus	Hiatal hernia with short esophagus; possible varices	Hiatal hernia with short esophagus; varices	Operation
9	Normal	Esophageal varices	Cirrhosis of liver with esophageal varices	Clinical course and liver biopsy

was performed. Five of these 9 cases showed significant lesions and 4 were normal. Positive findings obtained from the Hampton technic alone were not considered adequate for final diagnosis, even though they appeared conclusive. None of these 17 cases came to operation or autopsy.

RESULTS

Table I shows the diagnoses arrived at by the Hampton technic correlated with the final diagnoses. There were no false positive diagnoses in the series. In 3 cases the examination was considered technically unsatisfactory. Such findings as gastric prolapse, duodenal diverticulum, and small hiatal hernia are omitted, since they were not considered likely sources of the bleeding.

The 9 erroneous diagnoses in the series are briefly summarized in Table II. In Cases 3, 4, and 5 a regular gastro-intestinal examination was not done. In Case 6 the Hampton examination should not be considered satisfactory because of the pyloric obstruction. In Cases 7, 8, and 9 the mistaken diagnoses cannot be attributed to the method, since palpation played no role in the detection of the esophageal lesions present.

In Table III the diagnoses made by the Hampton technic are compared with those made from the subsequent gastro-intestinal series with palpation in the 57 cases in which both procedures were performed. In 11 of the 57 cases there was disagreement between the two methods. Subsequent events proved the findings with the Hampton technic to be correct in 3 and the findings on regular gastro-intestinal study to be correct in 4 In the remaining 4 cases a final diagnosis was never established. A staff radiologist reviewed the films and x-ray reports in these 57 cases, without knowledge of the final diagnosis, and found disagreement between the two methods in only 5 cases.

TABLE III: COMPARISON OF HAMPTON METHOD WITH SUBSEQUENT REGULAR GASTRO-INTESTINAL EXAMINATION

Final Diagnosis	Number Repeated with Palpation	Agreement	Disagreement
Duodenal ulcer	33	30	3
Gastric ulcer	5	4	1
Gastric carcinoma	1	1	0
Esophageal varices	8	5	3
Miscellaneous	2	2	0
Undetermined	8	4	4
TOTAL	57	46 (81%)	11 (19%)

DISCUSSION

What ill effects, if any, result from the performance of early roentgen examination without palpation in the presence of hemorrhage from the upper digestive tract? Since the signs of recurrent or persistent bleeding may not appear immediately, it is impossible to answer this question with certainty. Hampton (6),

Schatzki (13), and Elmer *et al.* (4) believe the method to be without danger, but Heuer (7) does not agree. We can only state that no apparent harm resulted from the use of the Hampton technic either in the present series or in earlier studies in this institution.

Certain aspects of the present study deserve comment. In the first place, a diagnosis of *active* duodenal ulcer was assumed in 14 cases in which the Hampton technic showed only a duodenal deformity. Although the failure to demonstrate a niche precluded an absolute diagnosis of active ulcer, the absence of other lesions in the face of severe bleeding indicated that the duodenal deformity was not likely a coincidental finding. This view was substantiated in those cases which were confirmed by pathologic examination. It is of interest that in no instance in either the Hampton or regular gastro-intestinal examinations was a niche seen alone. It was always accompanied by evidence of duodenal deformity of at least slight degree. It should also be stressed that an early Hampton examination may reveal an ulcer which cannot be demonstrated on later regular gastro-intestinal series (4 6, 13). In the present series there were 3 such cases.

Secondly, the absence of false positive diagnoses in this series is noteworthy. This is probably attributable in part to greater reliance upon the radiographic than upon the fluoroscopic findings, and in part to a general conservatism in interpretation.

Finally, the 86 per cent over-all accuracy of the Hampton method in this study compares favorably with that of regular gastro-intestinal examination as performed in this and other institutions (5). This figure was higher than we anticipated, perhaps because of our special interest in the subject. It should be emphasized that the Hampton studies were performed by residents. A staff roentgenologist (B. F.) reviewed the films and x-ray reports in all the cases without knowledge of the final diagnosis and obtained an accuracy score of 89 per cent.

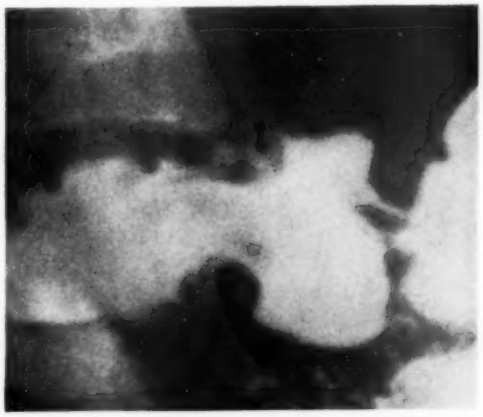

Fig. 1. Case 10. The clinical impression was hemorrhage from esophageal varices or peptic ulcer. Moderate duodenal deformity with crater (arrow) was demonstrated by early examination of the gastro-intestinal tract performed without the use of palpation. The diagnosis was confirmed at operation.

In our experience, the value of the Hampton technic as an aid in the diagnosis, prognosis, and therapy of acute upper gastro-intestinal bleeding has been considerable. The procedure is not intended to replace the routine gastro-intestinal examination, which is always indicated at a suitable interval (about fourteen days) after the cessation of bleeding.

Some of the advantages of immediate roentgen study by the Hampton method can best be illustrated by a few brief case reports:

CASE 10. F. B., a 59-year-old white man, was admitted because of hematemesis and melena. He gave a history of moderate beer intake and vague indigestion for several years. The hemoglobin level was 8.0 gm. per cent, and the red blood cell count was 3 million. The clinical impression was indeterminate (peptic ulcer or esophageal varices). A Hampton series, performed soon after admission, showed a duodenal deformity and niche (Fig. 1). Bleeding continued, and an emergency subtotal gastrectomy was performed on the second hospital day, revealing an active duodenal ulcer.

Comment: At first the diagnosis was in doubt. The true nature of the lesion was demonstrated by the Hampton procedure, which made possible prompt treatment.

CASE 11. S. H., a 44-year-old white woman, was admitted because of hematemesis a few hours earlier.

Fig. 2. Case 11. The clinical impression was bleeding duodenal ulcer. Marked esophageal varices were demonstrated by an early gastro-intestinal series (Hampton technic).

She gave a history of epigastric pain and seven bouts of hematemesis over the past three years. Gastrointestinal series elsewhere one and three years ago were said to have shown duodenal ulcer. The hemoglobin level on admission was reported as 6 gm. per cent.

It was the opinion of both the medical and surgical residents that the patient had a peptic ulcer and that emergency operation was indicated if bleeding continued. A Hampton examination performed at that point showed large esophageal varices (Fig. 2) and a minimal duodenal deformity. Consideration of emergency operation was abandoned. Bleeding stopped and did not recur during the remainder of the hospital stay.

Comment: Had it not been for the findings of the Hampton technic, this patient might have been subjected to an unnecessary surgical procedure.

CASE 12. H. C., a 59-year-old white man, was admitted with a history of epigastric pain for one week and severe hematemesis on the day before admission. The red blood cell count was 2 million and the hemoglobin level was 4 gm. per cent. A Hampton series on the day of admission showed a large hiatal hernia with an ulcer niche in the hernia at the level of the diaphragm (Fig. 3). Massive bleeding continued, and emergency operation became necessary. The roentgen diagnosis was confirmed, and a subtotal gastrectomy was performed through a thoraco-abdominal incision.

Comment: Operation through the usual rectus incision might have failed to provide the necessary exposure.

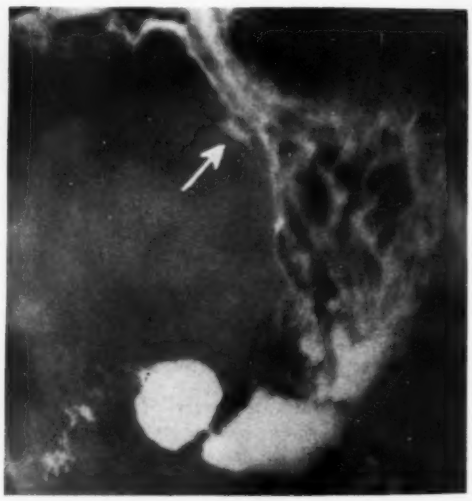

Fig. 3. Case 12. The clinical impression was bleeding peptic ulcer. Gastric ulcer (arrow) in hiatus hernia was demonstrated by early roentgen examination without palpation. Surgical approach was made through a thoraco-abdominal incision rather than the usual rectus incision. The diagnosis was confirmed.

SUMMARY AND CONCLUSIONS

In order to make use of the improved medical and surgical technics in the management of hemorrhage from the upper digestive tract, the source of bleeding must be determined as early as possible. Our experience with early roentgen examination carried out without abdominal palpation, as described by Hampton, has shown it to be both safe and valuable.

In a series of 80 unselected cases examined by this method during a one-year period, a diagnostic accuracy of 86 per cent was attained. This compares quite favorably with the results of regular gastro-intestinal examination as performed in this and other institutions. The Hampton procedure is not advocated to replace the regular gastro-intestinal examination, which should always be performed at a suitable interval after bleeding has ceased.

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SUMARIO

Diagnóstico de Urgencia de Hemorragia de la Porción Superior del Tubo Digestivo por el Examen Roentgenológico sin Palpación ("Técnica de Hampton")

A fin de utilizar los perfeccionamientos de las técnicas médicas y quirúrgicas en la asistencia de la hemorragia de la porción superior del tracto digestivo, hay que determinar cuanto antes el punto de origen de la hemorragia. La aplicación del examen roentgenológico temprano sin palpación abdominal, según la describiera Hampton, ha demostrado que este método es tanto inocuo cuanto valioso.

En una serie de 80 casos no seleccionados y examinados con la técnica de Hampton, se alcanzó una exactitud diagnóstica de 86 por ciento, lo cual se compara favorablemente con los resultados del examen gastrointestinal regular. No se recomienda el procedimiento de Hampton como substituto de dicho examen, que debe ejecutarse siempre en un plazo apropiado después que cese la hemorragia.

Two Unusual Tumors of the Diaphragm

MARVIN M. KEIRNS, Major, MC, USA

PRIMARY tumors of the diaphragm are rare. One of the two benign primary diaphragmatic tumors to be reported here was an adrenal cortical adenoma, apparently arising from an embryonal rest. This case is unique, in that no other tumors of adrenal cortical origin have been reported as arising in the diaphragm. The other tumor was an alveolar adenoma of liver tissue, also apparently originating in misplaced embryonic tissue. Gale and Edwards (1) previously reported a malignant hepatoma of the diaphragm; all other histologically diagnosed diaphragmatic tumors have arisen in tissues normally present in the diaphragm.

Reviews covering the literature up to October 1949, by Scott and Morton (2) and by Clagett and Johnson (3), cite only 40 tumors of the diaphragm reported since 1868, when Grancher (4) described the original case, a fibroma. Fifteen of the tumors were malignant, 21 were benign, and in 4 instances the type was either unconfirmed or the nature of the tumor was not reported. The diagnoses were as follows:

Benign Tumors	
Lipoma	7
Fibroma	3
Cyst (type undetermined)	4
Chondroma	1
Angioma	1
Lymphangioma	1
Hemangioendothelioma	1
Benign mesothelioma	1
Rhabdomyofibroma	1
Neurofibroma	1
Malignant Tumors	
Fibrosarcoma	6
Rhabdomyosarcoma	2
Myosarcoma	2
Leiomyosarcoma	1
Round cell sarcoma	1
Undifferentiated sarcoma	1
Mixed-cell sarcoma	1
Carcinoma of the liver (from embryonal rest)	1
Pathology not confirmed	4

CASE REPORTS

CASE I: The routine re-enlistment chest film of a 19-year-old Negro male revealed a shadow in the left lower lung field adjacent to the heart. Following a repeat roentgen examination, it was felt that this represented a diaphragmatic hernia or possibly a pleural tumor.

The patient was admitted to Fitzsimons Army Hospital on Sept. 24, 1946. He had no complaints on entry, but after repeated questioning showed a "falling off" of appetite and some loss of strength. No other symptoms were elicited. There had been no weight loss, and physical examination was entirely negative. Blood and urine studies were within normal limits and serologic examination was negative.

A gastro-intestinal series revealed an extensive defect, probably of extrinsic origin, in the anterolateral aspect of the cardiac end of the stomach, displacing the stomach downward from the diaphragm (Fig. 1). Following diagnostic pneumoperitoneum films of the chest and upper abdomen showed a well circumscribed mass lying below the diaphragm, attached to it but not to the stomach, and continuous with the tumor previously seen in the chest. The entire mass was approximately the size of the spleen (Fig. 2).

On Oct 21, the tumor was removed through a thoraco-abdominal approach. It was found to be adherent to the lower lobe of the left lung and to extend into the central tendon of the liver. The patient made an uneventful recovery. The pathologist's findings were as follows:

Gross Description (Fig. 3): The specimen weighed 200 gm. and was pear-shaped, measuring 8.5 cm. vertically and 9.5 cm. transversely in its widest portion (lower pole). The tumor proper appeared to be completely encapsulated. It was firm and elastic, and had a 9.5-cm. cuff of diaphragm, varying from 0.7 to 0.9 cm. in thickness, attached to the equator. The cut surface showed an encapsulated tumor with the peritoneal surface of the diaphragm covering the lower pole. A triangular piece of liver was firmly bound to the diaphragm and tumor, but separated by a glistening white fibrous "septum." A fragment of the left lower lobe was attached to the upper pole. The surface of the tumor proper showed

[1] From the Medical and Radiology Services, Fitzsimons Army Hospital, Denver, Colo. Read by title at the Thirty-seventh Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 2–7, 1951. Accepted for publication in July 1951.

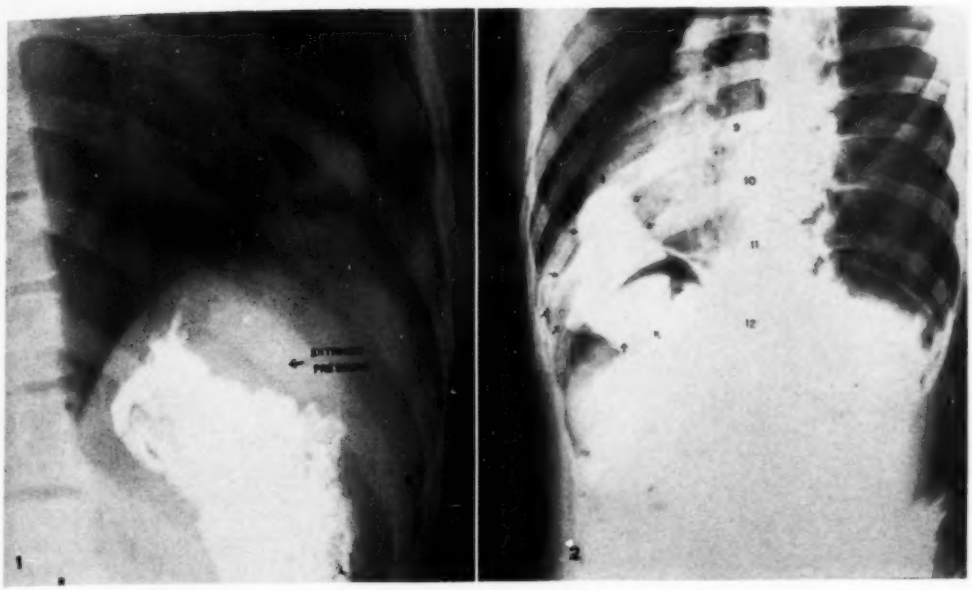

Fig. 1. Case I: Stomach film showing large filling defect in fundus.
Fig. 2. Case I: Diagnostic pneumoperitoneum, showing the tumor to be attached to the diaphragm but separate from abdominal contents.

a friable, ragged meshwork of grayish yellow to grayish white tumor that was more firm around the periphery. The entire surface leaked bright red blood.

Microscopic Description: Figure 4 shows polygonal cells with indistinct cytoplasmic membranes, finely granular cytoplasm, sharply defined round nuclei with a small dark nucleolus and finely granular chromatin. The cells show a cord-like arrangement. A fine fibrous meshwork supported the tumor and there were cavernous blood-filled spaces not lined by endothelium. The mass was completely surrounded by a thick hyalinized capsule, poor in cells and containing both calcium and hemosiderin deposits. The capsule did not merge with the capsule of the liver, and the tumor did not invade the lung.

Impression: Adenoma of liver, probably arising from heterotopic liver tissue, possibly arising from left lobe of the liver.

Comment: This case was reviewed by the staff of the Armed Forces Institute of Pathology and several other pathologists, with no unanimity of opinion. Several agreed with the above interpretation; others felt that the tumor was angiomatous or mesothelial in origin.

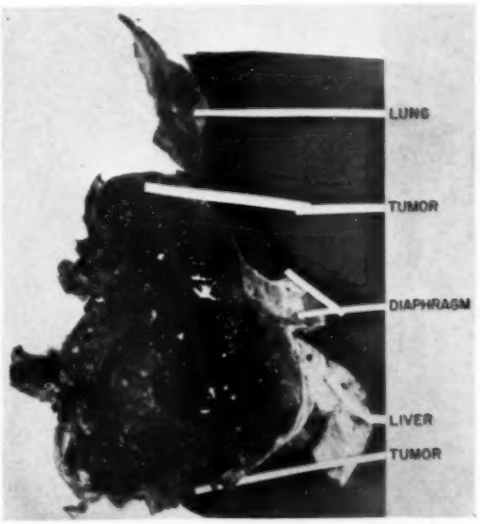

Fig. 3. Case I: Gross specimen showing relation of tumor to the diaphragm.

CASE II: A routine roentgenogram of the chest of a 31-year-old white man, taken on Aug. 1, 1949, in examination for ROTC, revealed a mass projecting into the stomach bubble but not, apparently, extending above the diaphragm (Fig. 5). Review of previous chest films, taken during the course of Army examinations, showed the mass to have been present since 1942.

On the patient's admission to Fitzsimons Army Hospital, the history and physical examination revealed no signs or symptoms associated with the lesion. Blood and urine examinations were normal.

A gastro-intestinal series revealed a smooth, rounded filling defect in the apex of the cardia, measuring 4 cm. across at the base and projecting 2 cm. into the lumen of the stomach. The overlying mucosa seemed to be intact. The left leaf of the diaphragm moved normally, the mass apparently moving with it and at no time projecting into the chest cavity. It could not be determined with certainty whether the tumor was in the diaphragm or gastric wall (Fig. 6). Further examination, after the induction of a diagnostic pneumoperitoneum and the administration of a CO_2-containing beverage to outline the stomach, showed the previously described mass to be definitely attached to the inferior surface of the diaphragm. Stomach and other abdominal viscera were well separated from the tumor by the air medium (Fig. 7).

On Aug. 25, 1949, operation was performed through a transthoracic approach. The mass, attached to the under surface of the diaphragm and palpable through the upper surface, was rounded, firm, and approximately 3 cm. in diameter. The diaphragm was incised and the tumor was found to be enclosed in a fold of the diaphragmatic peritoneum. The mass was slate-gray and had a rubbery consistency. It was excised along with a cuff of surrounding diaphragm.

The patient made an uneventful recovery. He had no manifestations of adrenal cortical insufficiency following surgery and resumed his studies as a medical student.

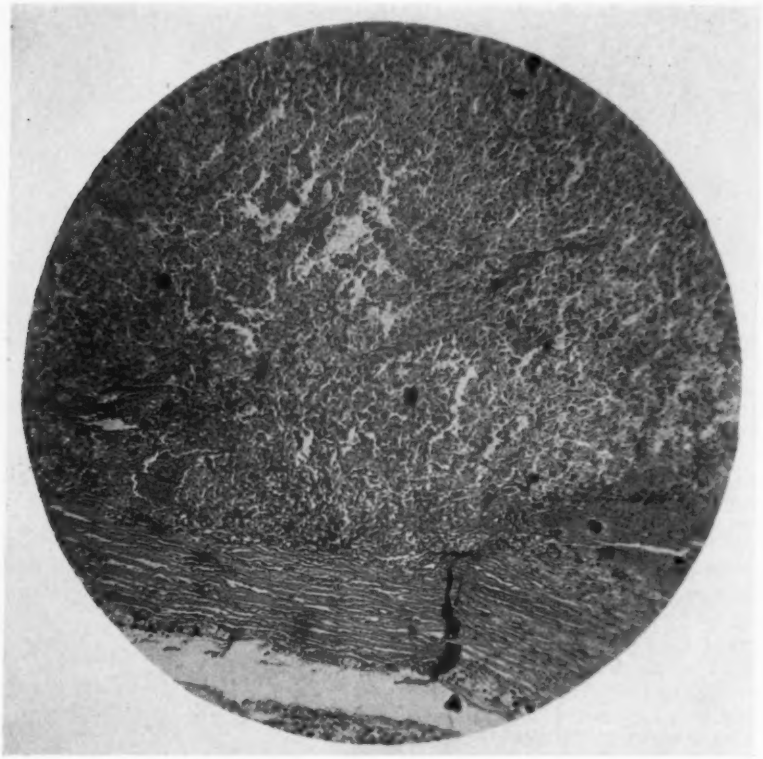

Fig. 4. Case I: Photomicrograph clearly demonstrating the histologic resemblance to liver tumor.

Gross Pathology (Fig. 8): The specimen was a 7.0 × 8.0-cm. sheet of the peritoneal covering of the left diaphragm weighing 12 gm. The central portion was an encapsulated flabby tumor 3.0 × 2.5 × 2.5 cm. The thin capsule fused with the peritoneum of the diaphragm. The cut surface was yellow, with an indefinite lobular arrangement, the lobules demarcated by narrow depressed trabeculae. Grossly, the tumor suggested adrenal cortex or a xanthomatous type of lipoma.

Microscopic Appearance (Fig. 9): The tumor was completely enclosed by a fibrous capsule fusing with the peritoneum. The tumor cells were polygonal,

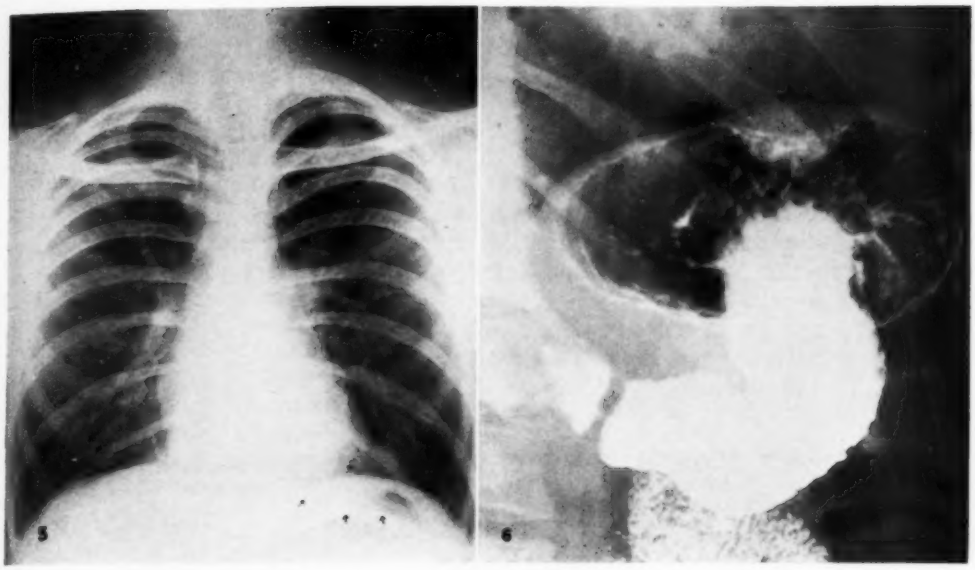

Fig. 5. Case II. Postero-anterior roentgenogram of the chest showing a filling defect in the stomach bubble.
Fig. 6. Case II. Stomach film after the ingestion of barium and a CO_2-containing beverage, showing the gastric mucosa to be intact over the filling defect.

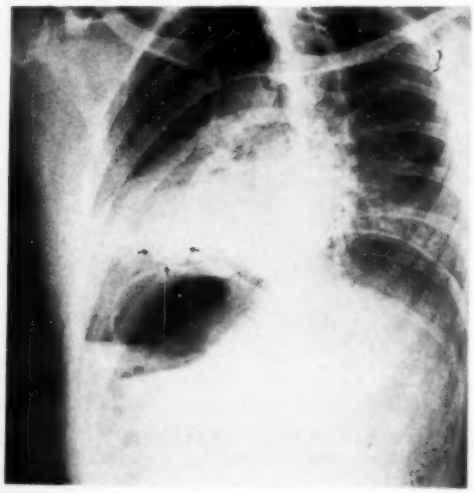

Fig. 7. Case II. Diagnostic pneumoperitoneum, clearly separating the mass from the abdominal viscera and showing it to be associated with the diaphragm.

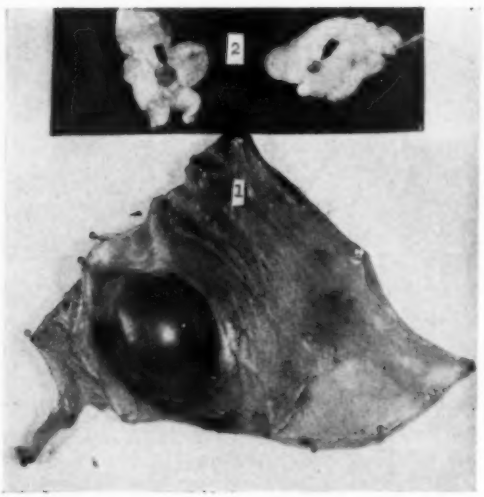

Fig. 8. Case II. Gross specimen removed at operation, showing the relation of the encapsulated tumor to the diaphragm.

lightly packed, with thin-walled veins running irregularly through the tumor. The narrow irregular trabeculae carried arterioles. Outside of the capsule and between the capsule and the surface of the peritoneum were groups of cells suggesting cells of the zona glomerulosa and zona fasciculata of the adrenal. Cells within the tumor suggested and contained brown lipochrome pigment similar to that seen in the zona reticularis of the adrenal. Outside of the tumor were also tubules lined by cylindrical cells, interpreted as the remaining cephalic portion of the mesonephros.

Impression: Adenoma in heterotopic adrenal cortical tissue of the left leaf of the diaphragm.

Comment: This case was reviewed by the Staff of the Armed Forces Institute of Pathology and because of differences of opinion was coded both as ectopic adrenal tissue and ectopic liver tissue.

DISCUSSION

In both of the cases described above a presumptive diagnosis was made on the basis of routine roentgenograms of the chest taken in the course of an Army physical examination. The precise location of the tumors was established by further roentgenographic and fluoroscopic studies. Diagnostic pneumoperitoneum, as described by Binney (5), and pneumothorax, as described by Söderlund (6), are especially important in establishing the fact that a tumor is in the diaphragm (Figs. 2 and 7). However, in the case of malignant tumors, separation of the pleura in pneumothorax or separation of the diaphragm from the abdominal contents in pneumoperitoneum may be prevented.

Müller's test is valuable in differentiation from an intra-abdominal mass. In the latter instance a paradoxical movement of the tumor with relation to the diaphragm is seen during respiration.

Fig. 9. Case II. Photomicrograph showing the tumor to be composed of polygonal cells and to present a pattern compatible with adrenal tumor.

The second case emphasizes the value of the stomach bubble, so frequently seen in the routine chest film, in the diagnosis of an intra-abdominal lesion. Poppel and Roach (7) point out the importance of the stomach bubble in lesions of the cardiac end of the stomach as well as other neighboring masses, as in this case. After the lesion is initially suspected, the stomach

bubble can be readily enlarged, by administration of a warm carbonated beverage, so as to delineate the region more clearly. Or better, double-contrast films may be made by first giving barium and then the carbonated beverage (Fig. 6).

Neither of these patients had any symptoms referable to the lesion. In only 12 of the previously published cases were symptoms absent or not reported. In the remaining cases they were vague and not at all diagnostic, consisting usually of pain in the chest, dyspnea, and cough. Preoperative diagnosis depends largely on roentgenography.

It is likely that the diagnosis will be made with increasing frequency because of the large number of people examined roentgenographically during mass chest surveys, when entering a hospital, or when seeking medical consultation. In the six decades from Grancher's original case to 1930, the diagnosis was made only 9 times. In the past two decades, 33 such tumors have been reported.

SUMMARY

1. Two benign primary tumors of the diaphragm are reported, an adrenal cortical adenoma and an adenoma of liver tissue.

2. Pneumothorax, pneumoperitoneum, and gastric air-contrast studies as aids in the roentgenographic diagnosis of diaphragmatic tumors are discussed.

3. The diagnostic value of the stomach bubble in routine chest roentgenograms is again emphasized.

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SUMARIO

Dos Tumores Extraños del Diafragma

De los 2 tumores primarios benignos del diafragma aquí estudiados, uno era adenoma suprarrenocortical y el otro adenoma del tejido hepático.

Providencias que parecen útiles en el diagnóstico de los tumores diafragmáticos son el neumoperitoneo, el neumotórax y los estudios gástricos con contraste aéreo. En ambos casos presentados, los tumores fueron descubiertos fortuitamente, diagnosticandose con el neumoperitoneo.

Recálcase de nuevo el valor diagnóstico de la burbuja gástrica observada en las radiografías torácicas corrientes. Una vez sospechado el diagnóstico, cabe agrandar dicha burbuja mediante la administración de una bebida gaseosa caliente, a fin de delinear la región más claramente.

Teleroentgenographic Pelvimetry

Preliminary Report[1]

DONALD R. GERMANN, M.D.

Accurate, dependable, and simple measurement of the female pelvis by x-ray has been an ambition of obstetricians and radiologists for years. Many methods have been devised. Every physician doing x-ray pelvimetry uses one of various modifications of the many standard pelvimetry methods available. These various modifications and methods are necessary with conventional radiography because the image on the film is not an exact replica of the pelvis, but is a distorted image due to the divergence of the beam. Since the planes of obstetrical importance are at varying distances from the film, the problem is one of multiple geometric corrections. This is not exceedingly difficult procedure; it is done every day. It is subject, however, to numerous sources of error, both human and physical, and the student or person untrained in x-ray pelvimetry may be misled by the images seen on the plane roentgenogram.

It is a basic physical fact that the percentage of distortion of the image is directly dependent on the object-to-film distance and on the target-to-film distance. It is theoretically possible, therefore, to increase the target-film distance to a point where the degree of distortion on the film is negligible. It is my experience, in routine x-ray pelvimetry, that no plane of the pelvis of obstetrical interest has an object-film distance of more than 20 cm., provided the table top-to-film distance is excluded. It is the impression of the clinicians with whom I work that a 5 per cent error in pelvic measurements is an insignificant one. The problem, then, is how great must the target-film distance be if any object 20 cm. from the film is not to be distorted more than 5 per cent. The solution is as follows:

$$\frac{\text{Target film distance}}{\text{Target film distance} - \text{Image distance}} = \frac{\text{Image size}}{\text{Object size}}$$

$$\frac{X}{X-20} = \frac{10.5}{10.0}$$

$$X = 420 \text{ cm.}$$

All films taken at this distance then would automatically be corrected for distortion within 5 per cent and measurements could be made directly from the film.

This, of course, is an astounding distance for those who are accustomed to considering 6-foot chest films as non-distortion films. In addition, the pelvis is a thick part and requires considerable x-ray intensity for penetration. The average technic for a lateral pelvis at 36 inches (approximately one meter) is 90 kv., 100 ma., and 1-1/2 sec. Since x-ray, like all other radiant energy, follows the inverse-square law, a 4-meter distance would require 16 times that exposure or 24 seconds at the same kilovoltage and milliamperage. No tube in our radiographic department will survive such an exposure. X-ray therapy tubes, on the other hand, will tolerate high-energy exposure for long periods. It became obvious, therefore, that if we were to realize our ambition and obtain non-distortion films, either a new radiographic tube must be designed or a therapy unit must be modified for radiographic purposes. We selected the latter method.

The next problem was finding a distance from the therapy tube of at least 420 cm. at which an attempt to take a film was possible. By aiming the therapy cone out of the door of the therapy room and against the wall of the inner corridor, a distance of 476 cm. could be obtained. This certainly put the target film distance beyond the 5

[1] From the University of Kansas Medical Center, Kansas City, Kans. Accepted for publication in September 1951.

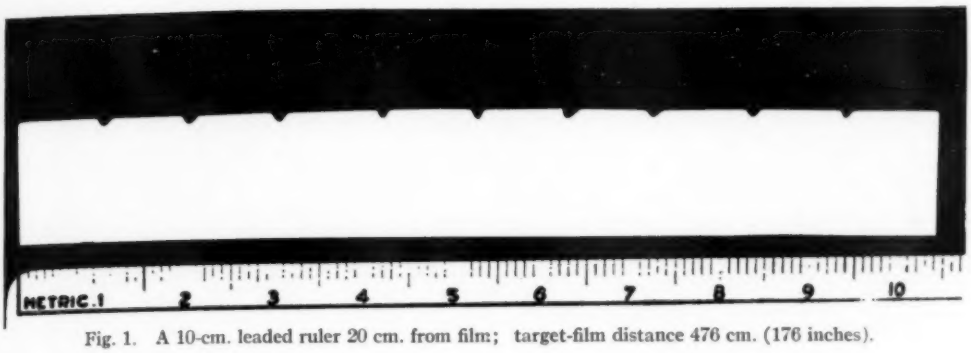

Fig. 1. A 10-cm. leaded ruler 20 cm. from film; target-film distance 476 cm. (176 inches).

per cent error range. Films, of course, had to be taken with the patient erect, which after all is the method of choice for pelvimetry films at any distance.

Several experiments were done to check the degree of distortion. Films of ping-pong balls filled with barium were taken at varying object-film distances and the sizes of the images were compared. A roentgenogram of a 10-cm. lead ruler was obtained at 20 cm. from the film and was found to measure slightly under 10.5 cm. Films were then taken of dried pelves and dimensions were compared. In all instances there was less than 5 per cent error (Figs. 1 and 2).

Events from this point on were quite gratifying. Mathematical formulae were no longer of help, at least in taking the radiograph. Patients were placed against the film at the described distance and an exposure was made. The film was then developed and another exposure made which was modified by the appearance of the previous film. For the best contrast a 10 × 12 Camp Lysholm grid cassette was used. It was found that a very readable film of the pelvis in the anteroposterior projection could be obtained at 476 cm., with 180 kv., 20 ma., and 5 seconds. If the patient is unduly large, the time or the kilovoltage, or both, may be increased. It has so far seemed preferable to increase the time. The lateral view of the average patient requires 180 kv., 20 ma., and 15 seconds exposure. If the kilovoltage is increased, the symphysis, coccyx, and ischial spines may be too dark for adequate interpretation. All possible filtration should be removed, so that more soft radiation for contrast is available. Unfortunately, in the equipment used, a half-value layer of 0.8 mm. copper remains after the filters are removed. The time could certainly be reduced if this were not true.

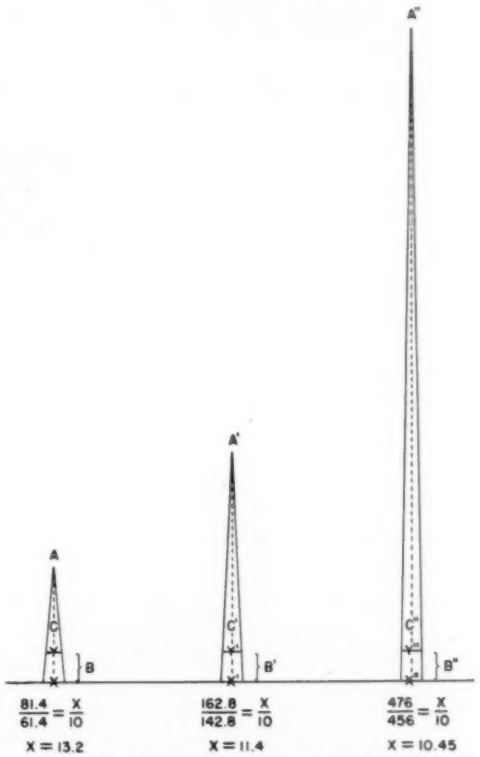

Fig. 2. Graphic demonstration of distortion of a 10-cm. object 20 cm. from the film, with target-film distances of 36, 72, and 176 in. (81.4, 162.8, 476 cm.), respectively. C. Target-film distance. B. Image distance (20 cm.). Y. Object size (10 cm.). X. Image size.

Figs. 3 and 4. Anteroposterior and lateral films for patient near term at 476 cm. distance. Factors for anteroposterior film: 200 kv., 20 ma., 5 seconds; for lateral view, 180 kv., 20 ma., 12 seconds.

The safety of the patient is always important. Therefore, a statement concerning the amount of radiation to which she is subjected is in order. With the described physical factors and 50 cm. distance, the standard therapy distance, 54 r per minute are generated. By increasing the distance nine times, the intensity falls to 0.66 r per minute. A fifteen-second exposure, therefore, subjects the patient to 0.165 r and a five-second exposure to 0.055 r. At first, this was an amazing finding, especially since conventional films of the pelvis each expose the patient to approximately 2.0 r. It is not surprising, however, when one considers that it is the beam which goes on through the patient (exit dose) which produces the photographic effect and not the amount delivered to the skin. Certainly therapy charts provide ample proof that the exit dose is much greater as the distance and kilovoltage are increased.

It is not the purpose of this paper to condemn the standard methods of pelvimetry. There are advantages and disadvantages in both methods. The advantages of teleradiographic pelvimetry are:

1. Accurate measurements may be obtained directly from the film without mathematical calculation. This eliminates a major source of error.
2. Any slight remaining error in direct measurements is always in excess of the true measurement and we are advised that this is negligible.
3. Since distortion is practically eliminated, there is no distortion of interpelvic relationships. All pelvic planes are distorted to essentially the same degree.
4. This method opens new fields in accurate study of the pelvic outlet and fetal size, neither of which has been free of criticism in the past. This will, perhaps, be the the subject for a future paper.

The disadvantages of teleradiographic pelvimetry are, of course, obvious. They are as follows:

1. The films are not of as good quality as those taken at standard distances.
2. High-voltage equipment is necessary. This, however, is not too serious a handicap, since x-ray therapy units are quite commonly available.
3. At least 420 cm. linear space is required, and this may not be available in crowded departments.
4. It requires some practice and experience to take films with a therapy tube as the source.

Since this is a preliminary report, no statistics will be given. The technic has been in use long enough that we are satisfied it is dependable. Films do not show the same contrast as conventional films but they are definitely readable. Clinical colleagues have been enthusiastic about the method and find good correlation between films and their clinical appraisal of the pelvis (Figs. 3 and 4).

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SUMARIO

Pelvimetría Telerroentgenográfica. Comunicación Preliminar

La técnica pelvimétrica aquí descrita elimina la desfiguración y permite obtener mediciones exactas directamente de la radiografía sin verificar rectificaciones matemáticas. Comprende un factor distancia a lo menos de 420 cm. y el empleo de un tubo de terapéutica para tomar la radiografía. Aunque la calidad no es tan buena como a las distancias corrientes, se produjeron radiografías anteroposteriores muy legibles a 476 cm. de distancia, con 180 kv., 20 ma. y exposición de 15 segundos. Para una vista lateral, se alarga la exposición a 15 segundos. Las radiografías se toman con el sujeto erguido, la cual es la posición de elección a cualquier distancia.

Intrathoracic Meningocele[1]

A Case Report

SIDNEY RUBIN, M.D.[2] and EDWARD H. STRATEMEIER, M.D.[3]

BECAUSE OF THE rarity of intrathoracic meningocele, only through individual case reports will sufficient information be accumulated to suggest the diagnosis and permit an intelligent handling of the patient. We therefore feel justified in reporting a case and evaluating the findings in those previously described.

REVIEW OF LITERATURE

Pohl (1) is credited with publishing, in 1933, the first case of intrathoracic meningocele. His patient was a 47-year-old female with associated Recklinghausen's disease. The meningocele arose from the intervertebral foramen at the fourth dorsal vertebra and projected laterally at the apex of a were marked kyphoscoliosis. The posterior ribs eroded. Roentgen findings were indicative of widening of the intervertebral foramen. This patient died postoperatively from empyema.

In 1938 Schüller and Uiberall (2) reported their findings in a 56-year-old man with Recklinghausen's disease and a right-sided thoracic tumor. On myelography they were able to observe retention of lipiodol in the mediastinal mass and a dimple of the medium at the 6th dorsal vertebra. Thus a correct diagnosis was suggested before surgery and subsequent death. Here again kyphoscoliosis of the spine was described, with the apex of the angulation in the region of the tumor. The widening of the intervertebral foramen was again noted.

A third report appeared in 1940, when Ameuille, Wilmoth, and Kudelski (3) added a case occurring in a 48-year-old female. The patient died as a result of empyema following an attempt to remove a meningocele (thought to be a hydatid cyst) on the right side between the eighth and ninth thoracic vertebrae. No evidence of neurofibromatosis is mentioned in this case.

In 1946, Campos (4) reported 2 probable cases of intrathoracic meningocele. One of the patients was a 7-year-old Brazilian boy with dorsal scoliosis and a right-sided mass demonstrable on x-ray examination. In addition, there were multiple anomalies of the first six dorsal vertebrae, including bifid vertebrae and synostosis of the fourth and fifth dorsal. The second patient was a Japanese male, fifty-four years old, with neurofibromatosis.

A sixth case, in a woman of fifty-one, with Recklinghausen's disease was reported in 1948 by Welch, Ettinger, and Hecht (5). The meningocele was on the right side.

In June 1949 Byron *et al.* (6) added 3 cases to the literature, 2 of which occurred in conjunction with neurofibromatosis. In the discussion of this paper Mendelsohn, Head, and Giaglia each presented a case. In 2 there was an associated neurofibromatosis. In the cases presented by Head and Giaglia the meningocele arose on the left side.

The thirteenth case was reported in September of 1949 by Cross, Reavis, and Saunders (7). In a patient with Recklinghausen's disease they were able to demonstrate a thoracic meningocele by air and pantopaque myelography.

CASE REPORT

A 7-week-old infant was admitted on Nov. 7, 1948. During the three days prior to admission, the child was seen several times by the doctor on the ambulance service because of convulsions, which were described as being generalized and tonic in nature, lasting only a few minutes. After admission to the hospital the convulsions ceased, and cyanosis

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and respiratory distress ensued. The respiratory difficulty was evidenced by rather marked rib and sternal retraction, and oxygen and tracheal suction were required for its relief.

The laboratory observations were not significant. The heart rate and rhythm were normal, with no significant findings in the lungs as noted by auscultation.

The chest film revealed an increased width of the supracardiac shadow extending primarily over the right side and lying in the posterior mediastinum. The heart and lung fields were not unusual. The trachea was displaced to the right and anteriorly. There was evidence of multiple anomalies of the dorsal spine with bifid vertebral bodies and synostosis of the 5th and 6th dorsal vertebrae. A study of the esophagus revealed the displacement to be to the right and anteriorly, with evidence of definite pressure on the posterior portion from the mediastinal mass. The differential diagnosis centered about posterior mediastinal tumors with no consideration given to the vertebral anomalies (11). There was no thought of meningocele.

Fig. 1. Chest film showing supracardiac mass extending primarily to the right side. Multiple defects of the dorsal spine are observed, with anterior spina bifida and increase in the intrapeduncular distances.

The patient's condition became progressively worse, and thoracotomy was not attempted. Death occurred on the twenty-fifth hospital day.

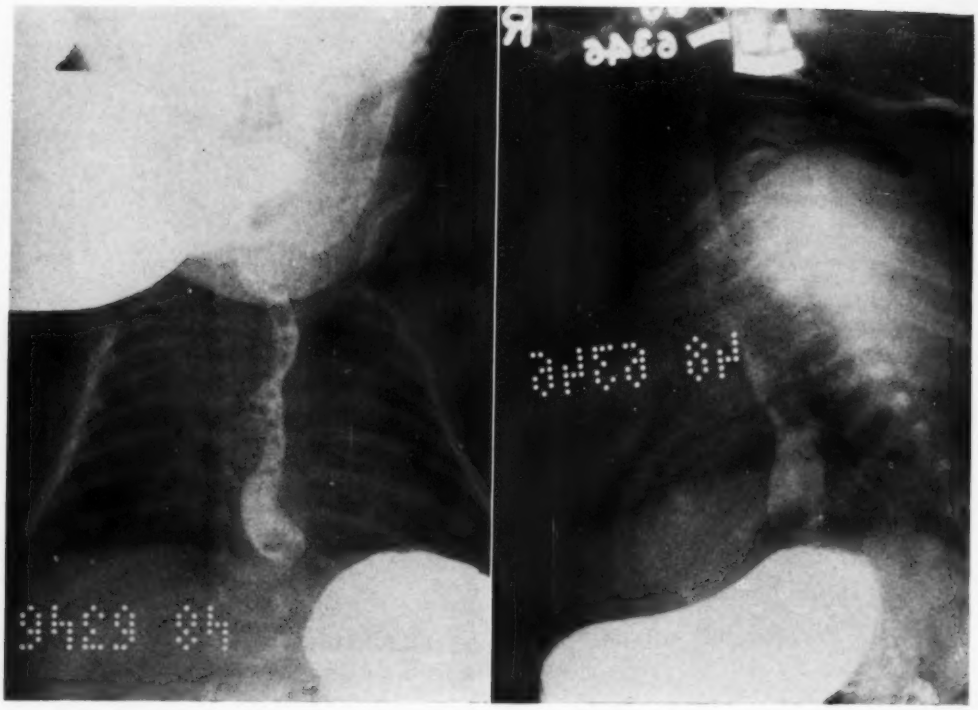
Autopsy: Situated in the upper right pleural cavity and extending out from the posterior mediastinum was a small rubbery mass approximately 2 cm. in diameter. This area was fairly compressible and covered with parietal pleura. It had displaced the right upper lobe downward and the trachea and esophagus to the left. The tumor was connected to a defect in the 4th thoracic vertebra through an isthmus of projected meninges. There was direct communication with the subarachnoid space of the spinal cord. The mass was cystic and contained spinal fluid.

Fig. 2. Soft-tissue mass in posterior mediastinum displacing trachea anteriorly.

Impression: Anterior thoracic meningocele extending through the body of the 4th thoracic vertebra.

DISCUSSION

Although mention is made of intrathoracic meningocele in Groedel's (8) textbook on roentgenographic diagnosis, the condition is almost never considered because of its rarity. It is usually believed that a posterior mediastinal or vparaertebral mass which enlarges the intervertebral foramina and causes absorption of the adjacent ribs posteriorly represents a neurofibroma. In the presence of a generalized neurofibromatosis the diagnosis is considered even more probable. Actually, however, the association of thoracic neurofibroma with Reck-



Figs. 3 and 4. Barium-swallow study revealing extrinsic pressure along the posterior and right upper surface of esophagus.

linghausen's disease appears to be surprisingly infrequent. Neurofibromatosis was found in none of 30 cases of neurogenic tumor reported by Blades (9) and in only 4 of 105 such cases reviewed by Kent and his co-workers (10). On the other hand, it was present in 9 of the 14 patients with intrathoracic meningocele. This relatively low incidence of neurofibromatosis in cases of thoracic neurogenic tumors and its frequent occurrence in association with meningocele should therefore at least favor the latter diagnosis and lead to myelographic studies for further confirmation.

The roentgen findings in the various cases have shown a rather notable similarity. In 12 of the 14 cases the tumor appeared as a right-sided soft-tissue mass projecting laterally through the intervertebral foramen, thus enlarging the foramen and producing kyphoscoliosis at the level of origin. The size and location of the meningocele varied, the smallest measuring 3 cm. while the largest practically filled the right thoracic cavity. In several of the reported cases there was evidence of multiple vertebral anomalies such as bifid vertebrae. Where myelographic studies were done, the medium was observed to enter the thoracic dural sac in small amounts.

In the usual case the thoracic tumor was in the main asymptomatic, in contrast to neurofibroma, which commonly produces neurologic signs and symptoms. The absence of neurologic findings in meningocele can be better understood when one realizes that the dural herniation does not enclose the spinal cord and the nerve tissue is thus left intact.

TREATMENT

Since intrathoracic meningocele appears only occasionally, any well substantiated criteria for its treatment are wanting. The fact that the condition is compatible with

life was appreciated by Byron and others. The majority of the patients were in the fifth and sixth decades. Observation is therefore advisable in cases where the mass remains stationary in size. If enlargement is demonstrated or symptoms develop, surgery is indicated.

SUMMARY

A case of intrathoracic meningocele is reported, believed to be the fourteenth in the literature.

Roentgen findings common to most of the cases are kyphoscoliosis, a posterior mediastinal mass projecting laterally through the intervertebral foramen, with enlargement of the foramen and absorption of the adjacent posterior ribs. In several cases, including the authors', there was evidence of multiple vertebral anomalies, such as bifid vertebrae.

Nine of the 14 cases were associated with Recklinghausen's disease. The association with the latter condition of a posterior or paravertebral mass, enlarging the foramen and causing absorption of the adjacent ribs, should suggest meningocele rather than neurofibroma. Relative freedom from neurologic signs or symptoms is further evidence in favor of a meningocele.

If the mass remains stationary in size, treatment should be conservative. If there is evidence of growth, surgical excision with closure of the dural sac is indicated.

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SUMARIO

Meningocele Intratorácico: Historia Clinica

El caso de meningocele intratorácico aquí descrito parece ser el décimocuarto comunicado en la literatura.

Los hallazgos roentgenológicos en común a la mayoría de los casos consisten en cifoescoliosis, presencia en el mediastino posterior de una tumefacción que proyecta a los lados a través del agujero intervertebral, con hipertrofia del agujero y absorción de las adyacentes costillas posteriores. En varios casos, incluso el de los AA., había, signos de múltiples anomalías vertebrales tales como vértebras bífidas.

En 9 de los 14 casos había asociación con enfermedad de Recklinghausen, y la asociación con este último estado de una tumefacción posterior o paravertebral, que agranda el agujero y ocasiona absorción de las costillas adyacentes, debe indicar meningocele más bien que neurofibroma. La relativa falta de signos o síntomas nerviosos es otro dato en pro del diagnóstico de meningocele.

Si la tumefacción permanece estacionada en tamaño, el tratamiento será conservador. Si hay signos de crecimiento, está indicada la excisión quirúrgica con cierre del saco dural.

The Country Radiologist

Presidential Address[1]

JOHN S. BOUSLOG, M.D.

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THE TITLE OF this paper is really a misnomer; it probably should be "The General Radiologist." Actually neither is adequate, for what I wish to convey is that the radiologist practising throughout the nation is like the old-fashioned country doctor or general practitioner as compared to the radiologist in a great metropolitan center. The country radiologist, in choosing his vocation, acquires responsibilities far beyond those of the radiologist in the large city. He is in reality a general practitioner specializing in radiology.

The decision to become a radiologist, like any decision, presents its own problems, the solution of which depends upon certain essentials. First there must be recognition of the problem itself, then its statement in concrete form, and then mobilization and arrangement of all contributory factors to permit formulation of a plan of attack. It is also valuable that it shall present appeal for being solved.

Before stating the problem it may be of help to review some rather long-established methods and procedures of rendering medical and surgical care. One might well question how many patients, with various ills, appearing in doctors' offices throughout the nation ever receive a complete physical examination before treatment is begun. It is common practice to confine the examination to the part of the anatomy associated with distress. Everyone understands that no physician has the time or the facilities to investigate completely every patient who enters his office each time that patient appears. But neither is the physician justified, on these grounds, in resorting to treatment of symptoms alone after only a cursory examination. He may find it advisable to do just that at first, but he can certainly arrange a later date which will permit him to complete his examination with the procedures necessary to establish a diagnosis.

As we all know but often overlook, diagnosis is the cornerstone of modern clinical medicine. It requires accurate observation and rational deduction. It is still the process of identifying a disease by painstaking consideration of the history, symptoms, physical signs, and the results of every pertinent type of examination.

The "human equation" is present in all human relationships, and in that of doctor and patient it is usually present to a greater degree than in most others. The medical profession, being made up of human beings, despite long study, training, and self-immolation of those human beings, is still subject to human foibles. A true physician is always alert to combat his frailties, but he must constantly subject himself to reflection and analysis, and must submit his conclusions to periodic critical evaluation.

As in all work, this evaluation will reveal a certain percentage of error. A professor of medicine once said: "See how accurate radiological work is. The radiologist cannot read the same film twice in agreement with himself or with another radiologist!" The analysis should begin with that of the physician's own scientific ability, and this will result in the evolution of steps to increase accuracy and ability to detect disease in its earlier and curable stages. It will disclose the personal variability which should make each one more critical of his own work and more tolerant in appraising that of others. Such evaluation of one's own ability also helps to create standards whereby young radiologists may profit.

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[1] Presented at the Thirty-seventh Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 2–7, 1951.

Members of this society have been responsible in a large measure for the high degree of proficiency which exists in our specialty throughout the country. The responsibility we bear as individuals and as a society has been great indeed and will remain so. Therefore there are problems which confront us, the radiologists.

Of primary importance to us, and therefore our major problem, is the necessity for closing the chasm—perhaps one should say bridging the gap—between the expert radiologist in the city and the average radiologist in the country. It would seem that one of the first steps in that direction is the training of young radiologists. That training should have certain objectives. Natural ability will always be evident wherever it exists, but the aim of the training course must be to develop ability which is latent or hidden. Many persons are inherently precise and accurate, but since radiology brooks no guesswork in any of its phases, so must the young radiologist be imbued with the paramount importance of accuracy and precision. He must be imbued with the knowledge that he is dealing in most cases with people who are ill, and that gentleness and care are also vital. He must never forget that he is a physician as well as a radiologist.

There is more to the making of a radiologist than producing a skilled technician. True, a good radiologist must be skilled technically and he must be conversant with physics, for as Dr. Quick has so ably pointed out, radiation therapy covers not only roentgen therapy but all the modalities which give ionizing radiation. Then, too, the clinical radiologist is called upon to make his own decisions at the time a problem occurs; he does not have a qualified physicist within reach of his voice, nor does he have the advantage of consulting with the faculty of a large teaching institution. He must have his resources within himself.

The residency training should be such that the young physician is a doctor first and a radiologist second. It should stress constant contact with clinicians; a working knowledge of the clinicians' problems, and a familiarity with their points of view. This can be obtained only by daily contact with patients under the care of experienced clinicians, surgeons, and pathologists. Those who are concerned solely with the operation of their mechanical gadgets and viewing films cannot adequately fulfill the role of radiologists.

On the other hand, because the country radiologist cannot call a repair man and have his machine fixed in an hour, as may be done in the city, he must be trained in the mechanics of his equipment, the technic of making films, and the handling of his machine. The production of good films is important. It is essential that he know what constitutes a good film, the effects of voltage and the details of processing, if for no other purpose than in order to instruct his technician in these matters. In fact, although it may seem most improbable to many of the young men, there are times when he may have to be, as I have been, the technician himself. The small rural community may not be able to provide all the facilities that exist in the city. Since most of the rural communities now have electricity, he may have to do portable roentgenography in homes many miles in the country.

May I repeat: the country radiologist in choosing his vocation acquires responsibilities far beyond those of his colleagues practising in the larger cities. He is in reality a general practitioner specializing in radiology. The radiologist in the country knows his patients and the patient knows his doctor. In fairness to himself and the patient, he should always see each one himself. Often each day a patient greets me with "Hello, Dr. John." Isn't that better than having him ask the technician, "Who is that man?"

In radiography, the ideal procedure is for the radiologist to see the patient first, obtain a history, and, if necessary, do a partial physical examination so that he can decide what films should be made. There are, of course, exceptions to all rules, and occasionally he may permit the technician to make certain routine exposures from

which he can proceed to the particular needs of the case. Often the radiologist can obtain some information in the history which the referring physician has missed and which is occasionally offers a clue to the diagnosis. For example, a patient was referred for determination of enlargement or calcification in the spleen. On the film of the abdomen, the lower part of the lung was visible, showing some suspicion of disease. Questioning the patient, who worked in a paint-spraying plant, revealed that he had worked for twenty years in the mines, and the diagnosis was established. There are similar experiences in therapy.

The training in therapy is deficient in that it does not permit following patients completely throughout their course of treatment. Experience in questioning young radiologists looking for locations shows that they can recite the technic perfectly but have not the knowledge of how to handle patients in private practice and how to meet the public. There are advocates for dividing diagnostic and therapeutic radiology so that each specialist should do one procedure only. This cannot be done in the rural areas, primarily because the amount of work does not warrant it. The question may be asked: Why not send such patients to the large centers? The answer is: One must consider the patient's economic condition. The necessity of his being away from home also makes it difficult for him to have proper care. Therefore, it is best to train the young radiologist as a general practitioner in radiology and leave the special fields to the specialists in the cities, where they can safely limit themselves.

How many radiologists in large cities see each therapy patient every time he is in for treatment? How many talk to him and see how he is feeling? How many question whether or not he should be treated today? How many check the dosage each time to determine if it is adequate or excessive? For the men practising in the country these matters are routine when they are properly caring for their patients.

The radiologist in the rural areas may be the one to decide on the method of treatment, and therefore he must know what is to be accomplished by radiation or surgery. He must keep abreast of advances in all fields of medicine. He must be always aware that he is caring for a human being and not an experimental animal, and his patients must be treated accordingly.

Because of the frequency with which the radiologist is called upon to treat it, cancer of the cervix may be taken as an example of the proper procedure in therapy. Here the evaluation of the case should rest upon knowledge based on a complete history and examination, including biopsy. This will permit evaluation of all factors and outlining of the treatment. Determination of end-results is dependent upon knowledge of the various therapeutic agents and the efficacy of each one An important problem which the man in the rural area often has to meet is the decision as to dosage, source of radiation, and general regimen of the patient. The young radiologist, therefore, should be trained to determine dosage, make depth charts, and figure radium emanation.

Also, the young radiologist should be taught the use of radioactive isotopes both as tracers and for therapy, and their employment in clinical work. Who is better equipped to understand radiation than the radiologist? He must be instructed as to the tools he is to use in his everyday practice: how they work, their possibilities and their limitations. The intent is not to make him a part-time physicist, but he does not have the advantage of being close to a physicist for consultation, and he must himself have that information.

We radiologists are indebted to the physicists for making us aware of the value and necessity of basic training in radiation physics. It is incumbent upon the country radiologist to use the available information, to integrate it with clinical problems, and to apply its theories to his practice.

Mention has been made of the sources of radiation as integral parts of the radiologist's armamentarium. It is deplorable

that radium therapy has been almost completely taken out of the hands of the radiologists. Why? Because they showed so little interest in its use, and the gynecologists, the surgeons, the dermatologists, and the otolaryngologists realized its potentialities and adopted it. Radiologists also made a mistake in permitting commercial firms to exploit the use of radium, to define the dosage, and thus permit anyone to use it. Apparently cobalt^{60} is likely to replace radium in many instances, and it is urgent that radiologists become acquainted with its proper use. If we, radiologists, permitted radium to go to other specialists by default, it is possible we may allow isotopes to do the same. In fact, in some localities, the internists are already adopting them.

While discussing the responsibilities of radiologists, it is well to ask who should lead the community in the problems posed by atomic warfare? There is but one answer—the radiologist, since he is trained to know the biologic effects of radiation and has the best foundation for understanding measures for radiologic defense. It is his duty to perfect his knowledge and to shoulder a large share of the burden of educating and indoctrinating the public in civil defense. Here, too, the radiologist has nearly lost by default. Had it not been for the activity of the American College of Radiology, he would indeed have done so.

However, all the training of our young men will be wasted if it is not controlled by standards which are universal. There is a deep responsibility on those who are charged with the standardization of procedures and the setting up of requirements for certification. Let them bear in mind that practice is as important as theory, and that being a physician as well as a radiologist is essential at all times.

The physician today can serve his practice, his community, and his country in many ways. Who can judge that one method or manner is better than another? In recent years the physician has been forced to change his thinking and his routine. He can no longer devote his time exclusively to practising medicine. He must realize his responsibility to inform the community of his aims, ideals, methods, achievements, and objectives. And he has found that it is well to take the general public into his confidence, to make people aware of his zeal for public and private welfare as well as his great share in the prevention of disease, education for better health, and constant study to improve man's living conditions. Since the physician has publicized himself, the public has rallied to his support. He may decry the socialization of medicine, but he should be grateful that it has made him recognize and assume his responsibilities in the political life of the nation.

Many a country radiologist can take credit to himself for his share in that publicity, for, although he does not have many of the advantages that are found in the large cities, he does have the pleasure of knowing his patients and of having his patients know their doctor.

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SUMARIO

El Radiólogo Campestre

En este Discurso Presidencial llámase la atención sobre las peculiares obligaciones que recaen sobre el radiólogo cuya práctica radica en las zonas rurales, alejadas de los grandes centros metropolitanos. Viene a ser el mismo en realidad un médico general que se especializa en radiología. Tiene además que poseer conocimientos de física radiológica, pues quizás no haya a mano físico a quien consultar; tiene que estar adiestrado en la parte mecánica de su instalación; sobre todo, tiene que ser primordialmente un médico, atendiendo de cerca al bienestar de sus enfermos, conociéndolos y siendo a su vez conocido de ellos.

Absorption of 2-mev Constant Potential Roentgen Rays by Lead and Concrete[1]

W. W. EVANS, M.S., R. C. GRANKE, B.S., K. A. WRIGHT, B.S., and J. G. TRUMP, Sc.D.

Cambridge, Mass.

ROENTGEN RAYS produced at constant potentials of 2 million volts are now available in compact apparatus for radiation therapy (1, 2), industrial radiography (3), and for biological and physical studies (4). It therefore becomes of interest to determine the protective value of lead, concrete, and other materials for this penetrating radiation and to compare its quality with that of the gamma rays from radium (5) and cobalt^{60} (6). Since x-ray absorption measurements made with constant potential equipment are preferred for purposes of comparison and standardization, the copper absorption curve and the half-value layer in copper, lead, and concrete were measured for these supervoltage rays and compared with the closely equivalent though less intense gamma rays from radioactive sources. The transmission of 2-million-volt constant potential x-rays through barriers of lead and concrete was determined for both small and large beams.

TWO MEV CONSTANT POTENTIAL RAY SOURCE

The 2-million-volt radiation was produced by a Van de Graaff electrostatic accelerator manufactured by the High Voltage Engineering Corporation and based on a prototype developed at the Massachusetts Institute of Technology. This radiation source is completely contained in a steel chamber, 3 feet in diameter and 6 feet long, the high-voltage elements being insulated in a compressed gas mixture of N_2 and CO_2 at 27 atmospheres pressure. The high constant potential of the Van de Graaff electrostatic generator results from the accumulation of electric charge on a well insulated metal terminal and conveyed by a rapidly moving insulating belt. The acceleration tube is of the grounded anode type with its cathode end within the high-voltage terminal. A steady equilibrium voltage is maintained by balancing the current transferred by the belt with the x-ray tube current.

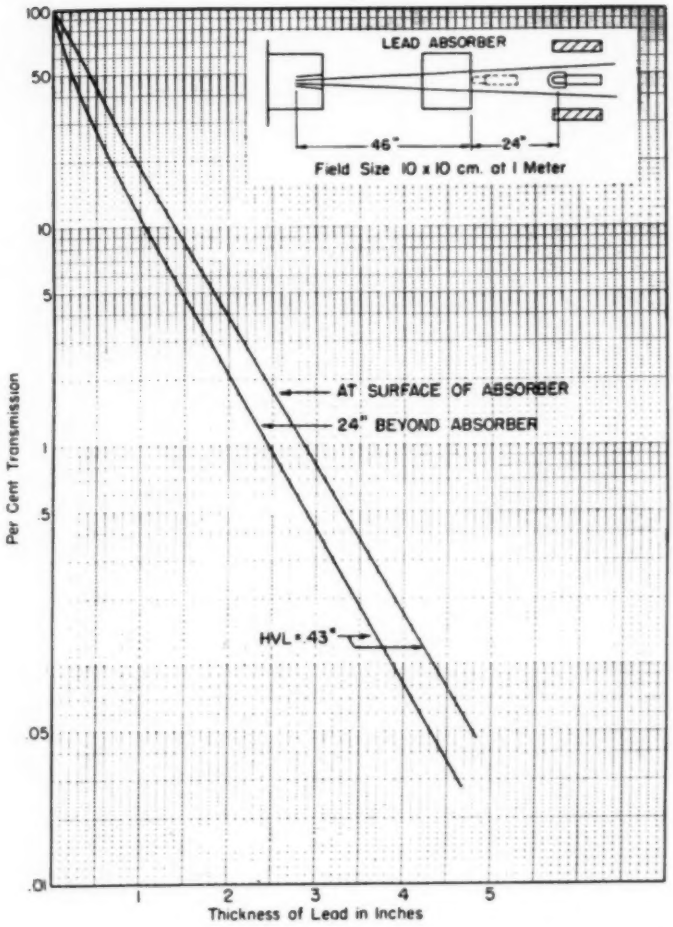
The output intensity of this Van de Graaff source at 2 million volts and 250 microamperes is about 75 r per minute, measured at 1 meter with an equivalent target filtration of 6.8 mm. of lead. This x-ray source is designed to operate routinely under these conditions for x-ray therapy.

The constant voltage of the x-ray generator is measured continuously by a generating voltmeter. This device actually measures the electric field intensity at the wall of the tank opposite the high-voltage terminal and gives a continuous and linear indication at the control panel. It was calibrated by observing the photon disintegration of beryllium, which begins sharply at photon energies of 1.63 mev. In this calibrating technic the voltage of the x-ray source is raised gradually until the onset of neutrons is observed proceeding from a piece of beryllium placed immediately below the x-ray target.

MEASUREMENT TECHNIC

Measurements of the x-rays transmitted through both lead and concrete barriers were made using the arrangement shown in the insert of Figures 1 and 2. Field sizes of 4 × 4 cm., 10 × 10 cm., and 30 × 30 cm. were defined with the aid of the lead enclosure and adjustable aperture system which surrounds the grounded anode of the tube. The side of the barrier furthest removed from the target was maintained at the fixed distance of 46 inches, and the barrier thickness was

[1] From the Department of Electrical Engineering, Massachusetts Institute of Technology, Cambridge, Mass. Accepted for publication in October 1951.



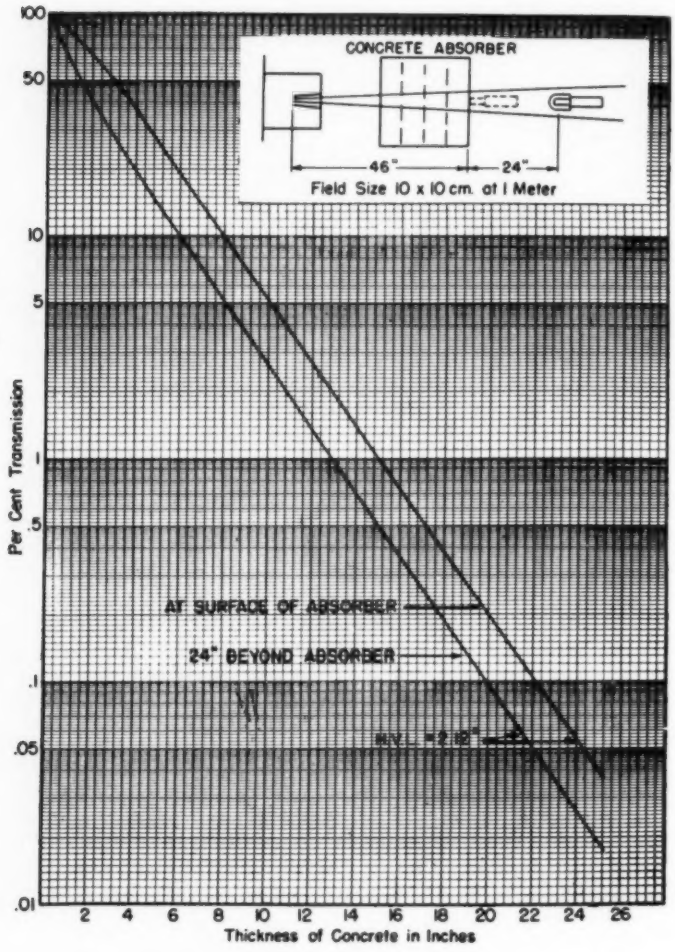
TRANSMISSION of 2.0 Mev CONSTANT POTENTIAL ROENTGEN RAYS THROUGH LEAD

Figure 1

increased by interposing additional lamina in the front of the stack.

Two ionization chamber positions were utilized in this work, one immediately behind the barrier and the other 24 inches beyond the barrier. Both were carefully placed in the center of the defined field. Standard Victoreen condenser-type ionization chambers were utilized for most of the measurements, the wall of the thimble being increased to a total thickness of 4 mm. by the addition of caps of lucite so as to establish equilibrium of ionization conditions within the air volume.

The lead and concrete barriers had dimensions in excess of that of the x-ray beam. The lead sheets were 12 inches square and either 1/4 or 1/2 inch thick; the concrete slabs were 24 inches square and 2 inches thick. The concrete was prepared with a 1:2:3 mix and had a density of about 2.4 grams per cubic centimeter. The contribution of back- and side-scattered radiation from the walls of the room was carefully determined throughout the work. After the initial intensity had been reduced to 1 per cent, this scattered radiation was discernible. Only in



TRANSMISSION of 2.0 Mev CONSTANT POTENTIAL ROENTGEN RAYS THROUGH CONCRETE

Figure 2

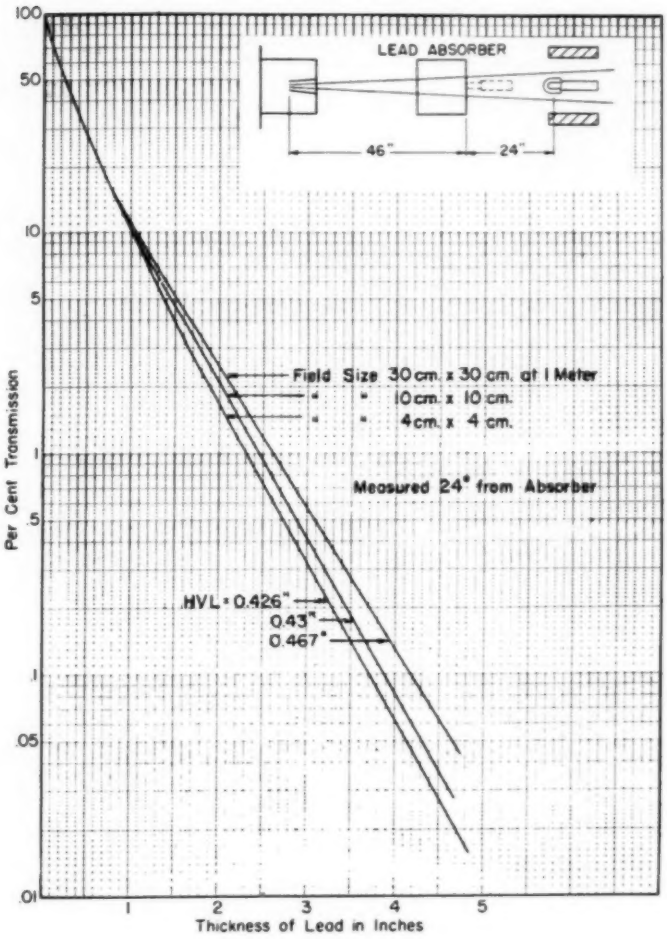
the case of the lead absorber and with the ionization chamber 24 inches behind the barrier did it become desirable to shield the chamber against such scattered radiation.

TRANSMISSION THROUGH LEAD AND CONCRETE

Figure 1 shows the transmission of 2.0-mev constant potential roentgen rays through lead for the case of a 10×10-cm. field at 1 meter. It can be seen that, after the first two half-value thicknesses, the x-ray intensity diminishes exponentially with increasing absorber thickness in accordance with the relation

$$I - I_o \epsilon^{-\mu d}$$

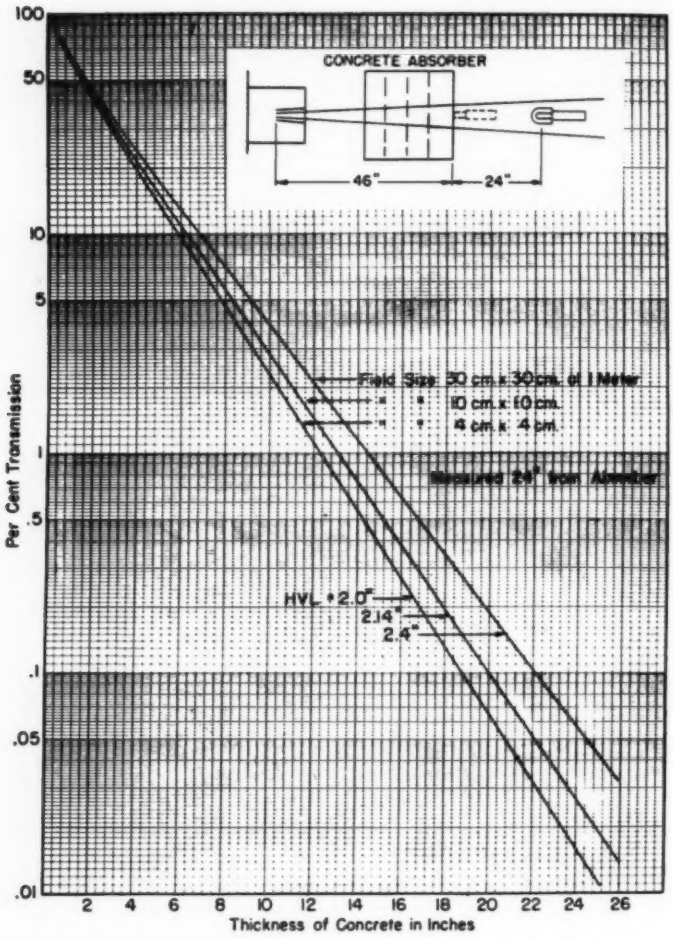
where I is the transmitted intensity, I_o the incident intensity, ϵ the Naperian base 2.718, μ the effective linear absorption coefficient, and d the absorber thickness in centimeters. Whether the ionization chamber is tight against the far wall of the barrier or 24 inches removed from it, the transmitted radiation shows the identical slope and therefore has the same absorp-



TRANSMISSION of 2.0 Mev CONSTANT POTENTIAL ROENTGEN RAYS THROUGH LEAD
Figure 3

tion coefficient and half-value layer. However, because of the contribution of forward-directed scattered radiation from the barrier itself, the transmitted x-ray intensity at the barrier wall is about two times higher than at a region 24 inches behind that wall.

Figure 2 shows the transmission of 2.0-mev x-rays through concrete. Again the straight-line nature of the transmission curve after the first few half-value layers of absorber thickness indicates that the transmitted radiation has become effectively homogeneous. For the case of the measurements made with the ionization chamber tight against the far side of the barrier, the apparently higher quality at the initial absorber thicknesses is due actually to the relatively large increases in scattered x-rays produced in the absorber. The soft components of these scattered x-rays, as suggested by Failla (7), may also have a greater relative effect on the ionization chamber than the parent high-energy radiation. It can be appreciated that these effects of the scattered radiation would be conspicuous only over the first h.v.l. thickness of the absorber and only when



TRANSMISSION of 2.0 Mev CONSTANT POTENTIAL ROENTGEN RAYS THROUGH CONCRETE

Figure 4

the ionization chamber is close to the source of this scattered radiation.

Figures 3 and 4 show the influence of x-ray field size on the transmission of 2.0-mev x-rays through lead and concrete, respectively. With both materials, higher transmitted intensities, apparently indicating more penetrating radiation, are obtained with the larger field sizes. This characteristic is due to the progressive increase with field size of the amount of scattered radiation reaching the measuring instrument from the absorber. The geometry chosen for these studies with lead and concrete is intended primarily to yield data useful for protection measurements. When measurements are made at short distances behind the barrier, the transmitted intensity is significantly influenced by the scattering volume. This emphasizes the need to make comparisons of radiation quality either under ideal conditions, as discussed below, or with the measurement arrangement precisely defined as to beam size and target, absorber, and instrument location.

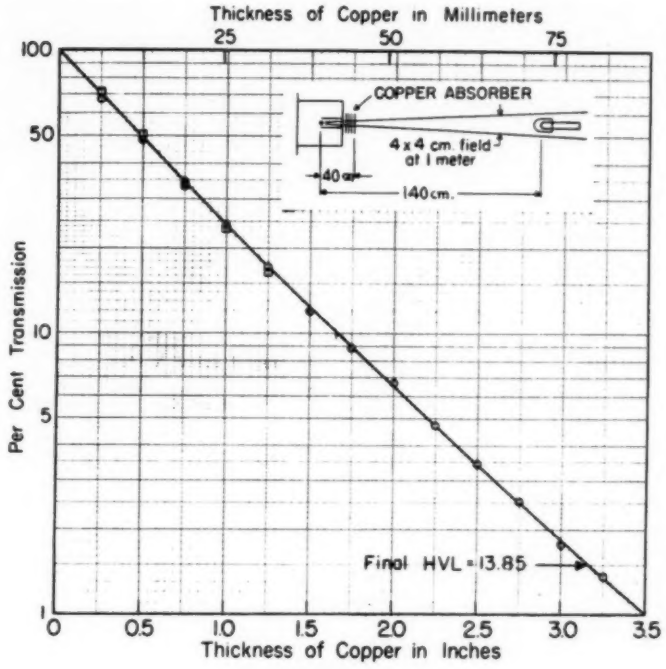


Figure 5

That the influence of field size on h.v.l. is less marked in the case of lead than with concrete is due to the greater ability of the higher atomic number material to absorb selectively the softer components of the scattered radiation by the photoelectric process.

COPPER ABSORPTION CURVE

Figure 5 shows the complete absorption curve in copper for 2.0-mev x-rays taken under the ideal conditions of a small field with the ionization chamber well removed from the copper filter. The absorption curve in copper of constant potential x-rays has become the standard method of comparing the quality of x-rays from various sources. This copper absorption curve was taken with the beam defined at the target to give a 4 × 4-cm. field at 1 meter and with the 2.0-mev x-rays filtered by the equivalent of 6.8 mm. of lead. The copper absorber, which completely covered the beam aperture, was about 30 cm. from the target, and the ionization chamber was 140 cm. from the target or approximately 100 cm. from the copper.

Under these conditions, the absorption measurements were almost entirely independent of the size of the beam over the range from 4 × 4 cm. to 30 × 30 cm. The relatively small increase in h.v.l. in copper from the initial value of 12.2 mm. to the final value of 13.4 mm. indicates the adequacy of the inherent filter of the gold target system.

RELATIVE ABSORPTION OF 2-MEV X-RAYS IN LEAD, COPPER, AND ALUMINUM

Figure 6 shows the transmission curves for 2-mev constant potential x-rays through lead, copper, and aluminum. These measurements were made with the ionization chamber at a distance of 100 cm. from the target in the center of a 10 × 10-cm. field. The target-to-absorber distance was 32 cm. The initial half-value layer thicknesses are 7.3 mm., 12.5 mm., and 38.5 mm. in lead, copper, and aluminum respectively.

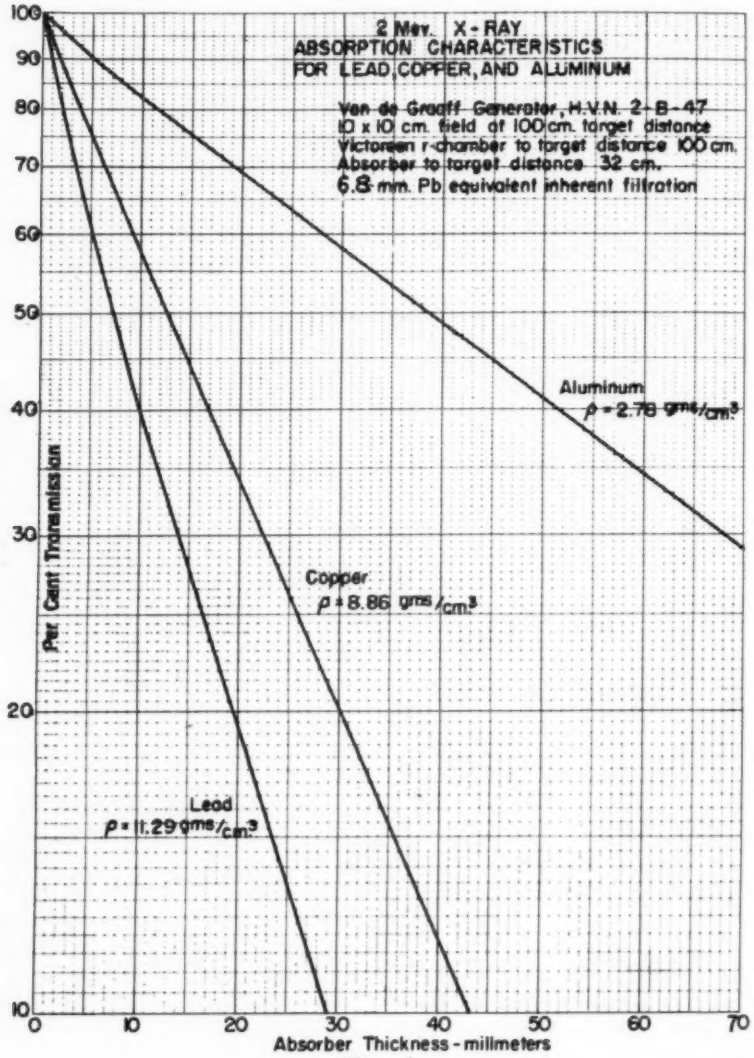


Figure 6

COMPARISON WITH RADIUM AND COBALT^{60}

The reported data are of value both for determining the amount of material required to attenuate the direct beam of 2.0-mev constant potential x-ray sources and for providing a basis of comparison with other supervoltage radiation sources.

Table I lists the initial and final values for the h.v.l. of lead, copper, and concrete for 2.0-mev constant potential x-rays. Corresponding measurements made by Wyckoff and his associates at the Bureau of Standards on the gamma rays of radium and of cobalt^{60} and by Braestrup on radium (8) are also listed.

Since the narrow beam measurements give the most accurate indication of relative quality, it can be observed that 2-mev constant potential x-rays and the gamma rays of radium and cobalt^{60} are all closely equivalent in quality as expressed by half-value layer measurements and fully equivalent for practical clinical purposes.

TABLE I

	HALF VALUE LAYER IN MM OF					
	LEAD		CONCRETE		COPPER	
	Initial Value	Final Value	Initial Value	Final Value	Initial Value	Final Value
2.0 million volt constant-potential X-rays						
4 x 4 cm. beam	6.30	10.9	36.8	51		
10 x 10 cm. beam	6.35	11.0	38.1	54	12.2	13.8
30 x 30 cm. beam	6.40	11.9	43.2	61		
Gamma Rays from Radium, 0.5 mm. Pt. filter.						
'narrow' beam	7.5*	13*	40	53		16.5*
'broad' beam (over 100 cm. dia.)		16*		68		
Gamma Rays from Cobalt 60						
'narrow' beam (about 7 cm. dia)		10.8		53.5		15
'broad' beam (over 100 cm. dia.)		12.5		58.5		

* Braestrup

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SUMARIO

Absorción por el Plomo y el Hormigón de Rayos X de Potencial Constante de 2 Mev

Tomando un foco de rayos X de un potencial constante de 2 mev, los AA. midieron la curva de absorción en cobre y la capa de hemirreducción en cobre, plomo y hormigón para dichos rayos de sobrevoltaje, comparando después los resultados con las correspondientes mediciones en los rayos gamma del radio y del cobalto^{60}. Midieron haces tanto estrechos cuanto anchos. A base de las mediciones de haces estrechos, que facilitaron la indicación más exacta de la calidad relativa, queda demostrado que los rayos de un potencial constante de 2 mev y los rayos gamma del radio y del cobalto^{60} son bastante equivalentes en calidad, segun expresan las mediciones de la capa de hemirreducción y absolutamente equivalentes para fines clínicos prácticos.

Monitoring of a Diagnostic X-Ray Department[1]

LILLIAN E. JACOBSON, M.A., JOEL J. SCHWARTZMAN, M.D., and SAUL HEISER, M.D.

AFTER THE Department of Diagnostic Roentgenology of Montefiore Hospital was moved to new quarters, a monitoring program was set up to include that department, the dental department, the Country Sanatorium, and every x-ray machine throughout the hospital.

There is as much need for the measurement of the radiation, both direct and stray in diagnostic roentgenology as in radiotherapy. The direct radiation from radiographic equipment is in a way self-limiting, for excessive output will be shown by overexposure of films. In fluoroscopic work, however, there is no obvious indication of the intensity of the radiation. The output at the table or at the surface of the patient may range from 3 r/min. to 120 r/min. (24). Since many machines do not have limiting timers, the patient may be receiving an erythema dose or more during a fluoroscopic examination. It is therefore imperative to know the output of every fluoroscope.

Much attention has been given to the radiation to which the patient is exposed, but too little to the amount which is received by the radiologist and other personnel. This includes direct radiation, when the field is not correctly shuttered or centered, and stray radiation from the tube housing and from the patient.

Workers with isotopes have been made aware of the danger of stray radiation and have been monitored continuously almost from the start. The radiotherapist is cognizant of the danger and has generally taken steps to be protected. The diagnostic roentgenologist, however, who may receive far more than workers of either of these types, has frequently been remiss in his protection, while other physicians have been thoroughly careless.

With the advent of isotopes, instruments have been developed which permit a quick survey of the stray radiation around a given space, such as Geiger counter survey meters and ionization chamber survey meters. Small direct-reading ionization chambers are available which can be worn by the individual and from which he can read the amount of radiation received during any procedure or during any period of time. Film badges, which have been used for years in the form of pennies or clips on dental films, have been perfected so that they can be calibrated for the type of radiation under survey and the stray radiation measured in milliroentgens (mr) by their blackening. Ring films can be worn on the finger, measuring the radiation which penetrates protective gloves.

An area survey of the therapy department at the Montefiore Hospital indicated that the stray radiation was less than 4 mr/wk. Film badges worn by the therapy technicians showed less than a measurable amount received in two weeks, which is less than 20 mr. In one of the isotope laboratories of the hospital, the workers received less than the measurable amount, 30 mr/wk., on this type of film. The highest amount received was 100 mr/wk. In another hospital, where considerable isotope work is being done, the chemist who took care of the "hot" work received an average of 100 mr/wk., while the rest of the personnel received an average of 30 mr/wk. or less. In diagnostic roentgenology at Montefiore Hospital, under good working conditions, with the best protective equipment available, the radiologists were getting around 50 mr/wk. In some cases the hand received more than could be measured by the density of a ring film, which is in excess of 20,000 mr. Den-

[1] From the Department of Diagnostic Roentgenology, Montefiore Hospital, New York, N. Y. Read by title at the Thirty-seventh Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 2–7, 1951.

tists and dental technicians were getting from 30 mr/wk. to more than could be measured on ring films. The need for careful and continuous monitoring in diagnostic roentgenology is thus obvious.

This paper is divided into two parts. Part I describes the methods of monitoring and the results obtained in routine diagnostic work. Part II describes the results obtained in special procedures.

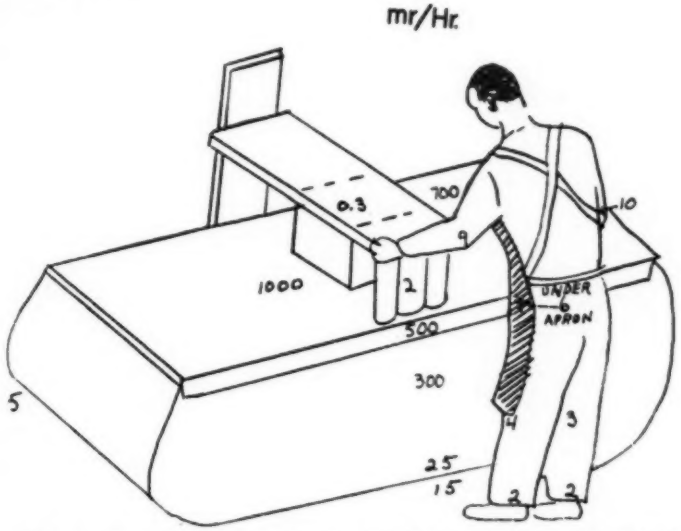

Fig. 1. Stray radiation measurements in mr/hour in room 3, as determined on a wax phantom, with 6 × 6-in. field, 83 kv., 4 ma., 3 r/min. output, h.v.l. 3.5 mm. Al.

PART I: ROUTINE DIAGNOSTIC WORK

Monitoring in Fluoroscopy: Procedures and Results

In the monitoring of fluoroscopic machines the following procedures were performed.

1. The output of the machine at the table top was measured and adjusted until it was no more than 10 r/min.
2. The half-value layer was measured to determine the quality of radiation.
3. An area survey was performed: (*a*) with a phantom simulating the actual conditions of fluoroscopy and (*b*) during the procedure itself where possible.
4. The personnel, including the radiologist, assistant, and others in the room, wore pocket dosimeters and carried cards for recording data.
5. The personnel wore film badges on the most exposed part of the body and a ring film on the finger of the hand used most often for palpating.

Output and Half-Value-Layer (h.v.l.): The output of each fluoroscopic machine was measured by means of a Victoreen 25 r chamber placed on the table top and centered fluoroscopically with a field of 5 × 5 inches. The output of different fluoroscopes in the hospital and sanatorium varied from 3 r/min. to 28 r/min.

The h.v.l. is a measure of penetrability and gives an indication of the ratio of the amount of radiation which strikes the screen to the amount which strikes the patient. The h.v.l. was obtained by adding aluminum filters, millimeter by millimeter, calculating and plotting the per cent transmission on semilog arithmic paper, and reading the thickness of aluminum necessary to reduce the radiation by 50 per cent. The h.v.l. for a voltage of about 90 kv. and an added filter of 2 to 3 mm. Al ranged from 3.5 to 4.5 mm. Al.

With a Patterson B2 screen, an output of

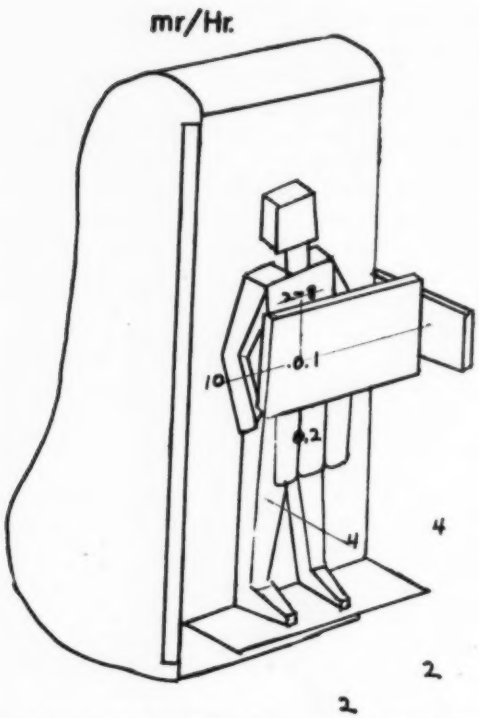

Fig. 2. Stray radiation measurements in mr/hour during a gastro-intestinal and chest fluoroscopic examination, room 3, 85 kv., 4 ma., 3 r/min. output.

8 to 10 r/min. is sufficient to give good visibility. This is the average of a number of fluoroscopes tested by one of the authors (L. E. J.).

Those machines which had an output higher than 10 r/min. generally had a low h.v.l. When the machines were opened to permit the examination of the filter, it was found to be less than 2 mm. Al. Filters were added up to a maximum of 3 mm. Al. If this did not decrease the output sufficiently, the milliamperage was decreased until the output was about 10 r/min.

The low output of 3 r/min. for one machine was not increased because the fluoroscopist said that this gave him good visibility. The same type of tube and control was measured at another institution. The output was 5 r/min. and good visibility was also obtained.

Area Survey: The Department of Diagnostic Roentgenology has six rooms assigned to radiography. Three of these, rooms 3, 5, and 6, are also used for fluoroscopy. The rooms are large, each measuring about 16 × 21 feet. Each diagnostic room is lead-lined to a height of 7 feet with 1.5 mm. of lead. The fluoroscopic tubes are in enclosed tables with the exception of one in room 5, where the back of the table was open.

The stray radiation was measured with an ionization chamber survey meter. For low values, a Geiger counter type survey meter was used. Both instruments were standardized with a radium standard.

Outside the rooms the stray radiation was measured by moving the meter up and down along the walls. No measurable amount was detected.

The stray radiation was then measured inside the room in the position of the fluoroscopist, with a wax phantom, 7 × 8 × 10 inches, in front of the screen, below and to both sides of the screen, and in the region of the fluoroscopist's legs and feet. Results for room 3 are shown in Figure 1.

Measurements of stray radiation in this room were also made during actual fluoroscopy. In order to make the meter visible when the room was darkened, a small flashlight, covered with red paper and a shield of lead, was fastened to each meter. The results are shown in Figure 2. The discrepancy between phantom measurements and those in routine fluoroscopy is due partly to the difference in the size of the field, an important factor in the amount of radiation scattered. It is attributable also to the absorption of the scattered radiation by the volume of the body outside the field, which is larger than that of the phantom. The phantom measurements, then, give the upper limit of scattered radiation for this particular set-up.

Personnel Survey: To determine what cumulative dose of stray radiation the radiologist or other physician in the fluoroscopic room was receiving, pocket dosimeters were worn. The cloth holder pictured in Figure 3, containing the dosimeter, could be tied or fastened to any part of the

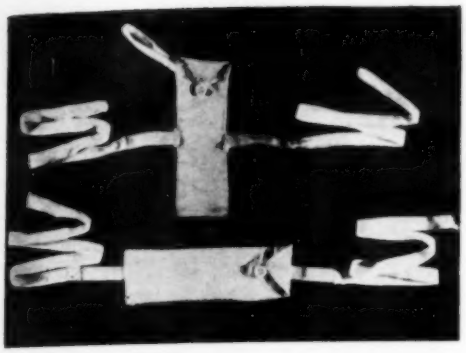

Fig. 3. Cloth holders for pocket dosimeters.

body. The staff men carried a card on which the following items were recorded: date, room, procedure, vertical or horizontal, part of body where meter was worn, time of fluoroscopy, dosimeter number, dosimeter reading at beginning and at end in mr. At first it was difficult to get the staff to record the data. One incident, however, helped to bring about good cooperation. Two of the residents had been wearing the dosimeter under their cloth-covered lead-rubber aprons. One consistently got a higher reading than the other. It was suggested that he examine his apron and to his surprise he found a break in the lead-rubber which could not be seen on casual inspection.

By analyzing the card data much valuable information was obtained. It was found that in room 5 the reading at one end of the table was very high in the region of the fluoroscopist's leg and ankle during horizontal work. The stray radiation on this fluoroscope, which had no table housing at that end, was measured by a pocket dosimeter hung from the table in the required position and found to be 30 mr/min. A lead housing was built around the tube and the figure was reduced to 3 mr/min. The stray radiation received by one resident was high on the upper arm. He was asked to cut down the size of the shutter opening and the stray decreased notably.

The data were tabulated and reduced, for each position, to mr/min. The stray for each position was averaged for at least six recordings for each member of the

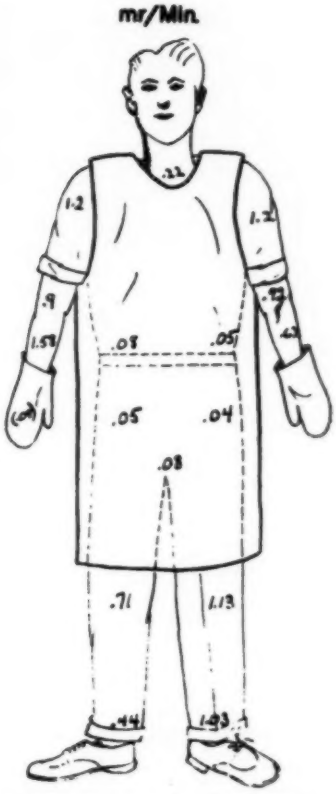

Fig. 4. Average stray radiation in mr/min. received by Radiologist S during routine fluoroscopy in rooms 5 and 6. Figures in parentheses obtained from ring film.

radiological staff. In Figure 4 the average mr/min. are shown on the various parts of the body for staff member *S*, who worked in rooms 5 and 6. Under the glove the reading, enclosed in parentheses, was obtained from ring film values. Figure 5 is a similar schematic stray survey picture for staff member *Sa*, who worked in the same two fluoroscopy rooms. Notice the large amount under the apron in the pubic region. This was due to a crack in the apron, as previously described. The exposure for member *H*, who worked most of the time in room 3, where the output was 3 r/min., is given in Figure 6. The stray radiation which this member received is less than for the others. The stray radiation received by the backs of radiologists *Sa* and *R* in rooms 5 and 6 is shown in Figure 7.

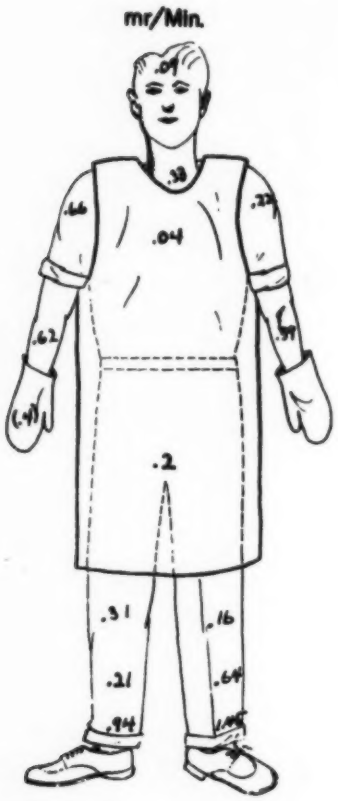

Fig. 5. Average stray radiation in mr/min. received by Radiologist Sa during fluoroscopy in rooms 5 and 6.

Every staff member was required to keep a record of each day's fluoroscopic time, and the average weekly exposure was calculated for each individual. The variation between staff members was from 30 min./wk. to 62 min./wk.

The average stray radiation received per week for personnel engaged in fluoroscopy in rooms 5 and 6 was computed from the mr/min. figures, with fifty minutes as the average time of exposure per week. The results are given in Figure 8. These doses are now well below tolerance. They would have been higher in the region of the legs and feet if the x-ray tube in room 5 had not been enclosed in a lead housing, as noted above.

All the members of the x-ray staff, including technicians, and of the dental staff were monitored by film badges. The badges, which were obtained from the Atomic Energy Commission (A.E.C.) at Oak Ridge, were calibrated for 100-kv. x-rays, h.v.l. 1.98 mm. Al. It may be pointed out here that badges should be worn where the maximum radiation may be received. The radiologist who wears an apron should place the badge on the upper arm, on the forearm, or on the leg; the technicians and dental staff at the waist or table level. Too often the badge is worn on the lapel, which is behind the lead glass of the fluoroscopic screen and is the most protected position in fluoroscopy. Even though they know that the wearing of the badge is for their own protection, some workers become lax unless a method of checking up on them is carried out.

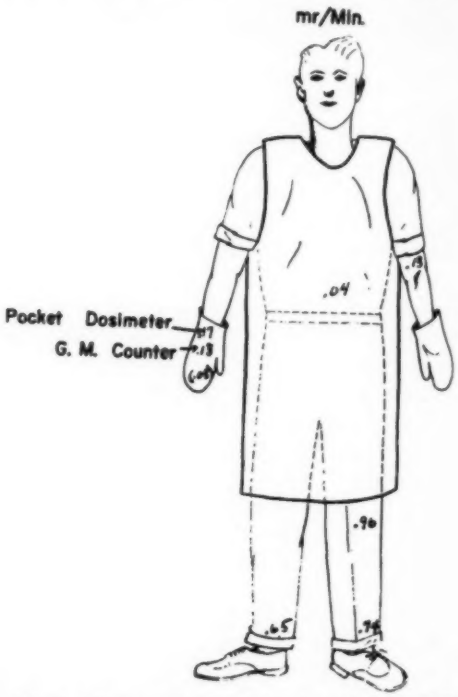

Fig. 6. Average stray radiation in mr/min. received by Radiologist H during routine fluoroscopy in rooms 3 and 5. Figures in parentheses obtained from ring film.

The film badge values for the radiologist varied from 0 to 40 mr/wk., which is about the average stray received on the upper

arm, as computed from the pocket dosimeter readings and shown in Figure 8.

Badges worn by the dental staff indicated that they were receiving much higher stray radiation than the x-ray staff, the amount in some instances exceeding tolerance. By the installation of lead screens, behind which the operator stood during exposures, the stray was reduced to a negligible amount.

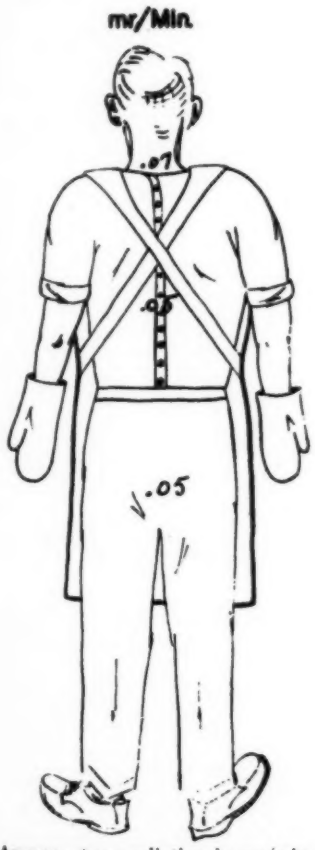

Fig. 7. Average stray radiation in mr/min. received posteriorly by Radiologists Sa and R during routine fluoroscopy in rooms 5 and 6.

Lead rubber mittens, whose lead equivalent is 0.5 mm., are regularly used in the diagnostic department. Each radiologist was required to wear a ring film on his right hand. This ring was obtained from the A.E.C. at Oak Ridge, and was calibrated for x-rays. If the exposure was shown to be too high or higher than the average, it was an indication of faulty technic, *i.e.*, that the hand was kept too long in the x-ray beam or the gloves were cracked. The normal exposure on the ring varied from 0.09 to 0.4 mr/min. The average was 0.14 mr/min. This gave an average of 7 mr/wk.

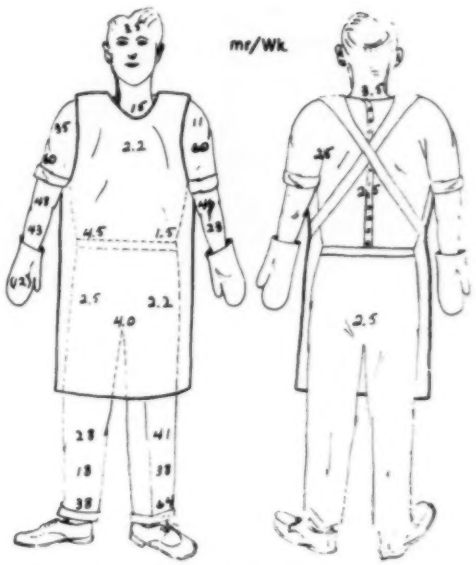

Fig. 8. Average mr/wk. for fluoroscopic personnel in rooms 5 and 6. Fifty minutes per week is average fluoroscopic time. Figures in parentheses obtained from ring film.

The hand was also monitored: (*a*) by placing the Geiger counter in the mitten, which gave an average of 0.16 mr/min. for the right hand, and (*b*) by placing the pocket dosimeter in the gloves, which gave a value of 0.13 to 0.17 mr/min.

All these methods are in good agreement.

Spot Films: During the exposure of spot films, the needle on the survey meter went beyond its measurable limits. To ascertain the output and stray for spot filming, a presdwood phantom, 20 cm. thick and 30 × 30 cm. in cross section, was used with the table in the horizontal position. The field size on the screen was 4 × 5 inches. The entrance dose was measured with a Victoreen 25 r chamber and the exit dose by a pocket dosimeter calibrated by a 0.25 r Victoreen chamber. The conditions

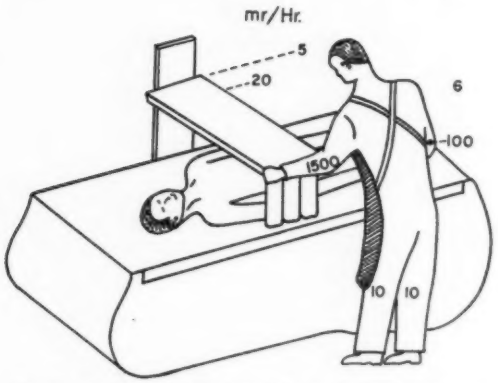

Fig. 9. Stray radiation in mr/hr. as found by an area survey during myelography.

of operation for the x-ray tube when used for fluoroscopy were 90 kv., 5 ma., and an added filter of 3 mm. Al, h.v.l. 3.5 mm. Al. The output at the table top with the phantom was 4.1 r/min.; the exit dose was 54 mr/min.

To get the number of r per exposure of a spot film with the same tube, four successive spots were taken and the ionization chambers read. The conditions of exposure were 90 kv., 300 ma., 1/6 sec. The dose per spot at the table was 0.98 r. The exit dose, or what struck the fluorescent screen, was 12 mr per spot. The exposure of a single spot film was approximately the same as 15 seconds of fluoroscopy. In other words, four spots are equivalent to one minute of fluoroscopic exposure. It is reasonable to assume that the stray radiation from four spot exposures would also be the same as for one minute of fluoroscopy.

Survey of and Recommendations for Extra-Departmental Work: Every fluoroscope in every department of the hospital and sanatorium was measured, and a report was made to each person in charge of using this equipment. Some of the corrections recommended were as follows:

1. Reduction in output by adding more aluminum filters.
2. Reduction in output by decreasing the milliamperage.
3. Change of screen to Patterson B2 to provide better visibility.
4. Better centering of the beam. In one installation the beam was near the top of the screen even for a small field, and when the field was increased, the beam was outside the screen. In another installation the beam was in the bottom left-hand quadrant. The former machine gave a large stray above the screen, the latter a large stray below the screen.
5. Hanging of a slotted lead rubber apron from the screen to protect against stray coming from the patient in the horizontal position and that coming through below the screen in the vertical position.
6. Fixing the shutter system so that under no condition can it be opened beyond about an inch from the edge of the screen.

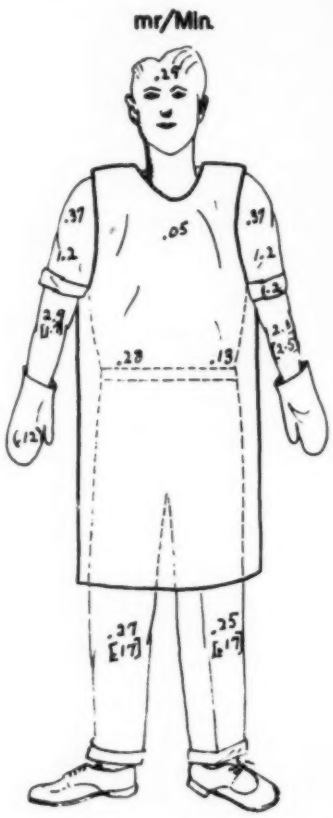

Fig. 10. Average stray radiation received by radiologist during a myelography in mr/min. Figures in brackets obtained from area survey.

In most cases there is a need to educate the staff in other departments in the

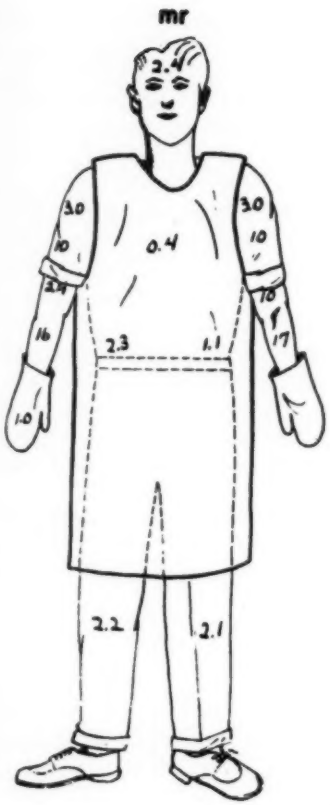

Fig. 11. Average stray radiation in mr received by radiologist during an average myelography of 8.2 minutes duration.

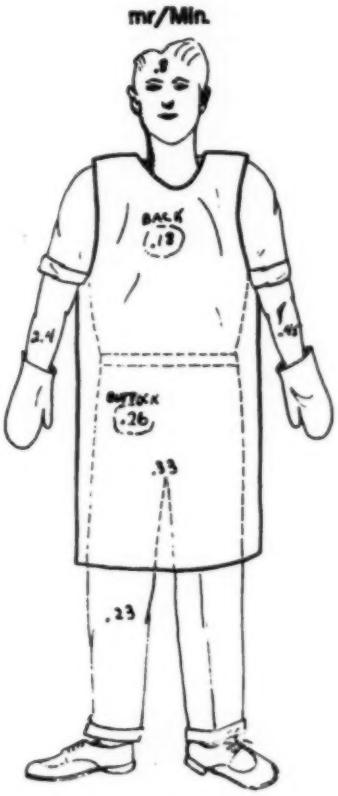

Fig. 12. Average stray radiation in mr/min. received by the neurosurgeon during a myelography.

hazards of x-ray work. The direct beam is respected because its presence is made known by the fluoroscopic screen, but stray is thought to be non-existent.

Generally the personnel who get the most stray radiation are non-radiologists, who have little training in the physics of x-rays and therefore no "healthy respect" for the dangers involved. One physician, who used an office fluoroscope of which the output was calibrated in a study by Sonnenblick *et al.* (24) and found to be 118 r/min., eventually developed leukemia.

After this "protect-against-radiation campaign" was begun, individuals associated with the hospital wanted to know how much exposure they were getting in private practice. A simple way to check this was to lend them pocket dosimeters and instruct them in their use or give them film badges to be worn for a fixed period of time.

Monitoring in Radiography: Procedures and Results

Unless the x-ray machine is run for at least two seconds, it is not possible to read the survey meters correctly because both the instrument and needle have a time lag. A rough indication of the radiation output can be obtained by reading the meter as a ballistic meter. In doing an area survey those conditions of voltage and milliamperage should be used which allow the machine to be run for at least two seconds.

Pocket dosimeters or film badges can be attached to the walls by Scotch tape and allowed to remain for a definite number of exposures and the stray radiation per exposure calculated if it is significant.

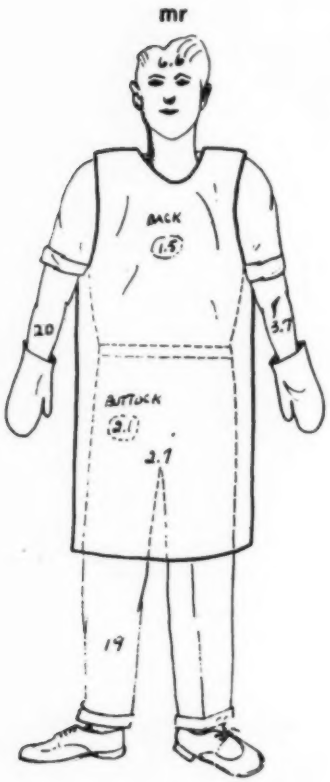

Fig. 13. Average stray radiation received by the neurosurgeon in mr during an average myelography of 8.2 minutes duration.

Personnel monitoring in radiography may be accomplished in the same manner as in fluoroscopy.

Area Survey: The stray at the open door, 11 feet away from the cassette and just out of line with it, was found to be between 1 and 3 mr/hr. At the control stand behind the wall it was not measurable. Nevertheless, the technicians were instructed to stand at the control and never at the open door.

Personnel Survey: The technicians were monitored by film badges. An inspection was made each morning to be certain that the badges were worn so as to insure reliable data. Without some such checking system for both physicians and technicians, it is not long before a careless attitude is acquired and the badges are worn only occasionally.

The highest amount received per week was 25 mr, the average about 7 mr. These values were obtained after the technicians were trained in proper safety technics. No figures are available for the "before" period.

Portable X-Ray Work: The portable equipment was monitored during the actual taking of x-ray films. Initially the technician stood at the control stand, 3 to 4 feet from the patient, and received 3 to 6 mr per film, depending on where he stood and upon the conditions of operation. The survey meter at the control stand read about 600 mr/hr. To reduce the stray radiation, the technician was instructed to go as far away as possible (the cord on the

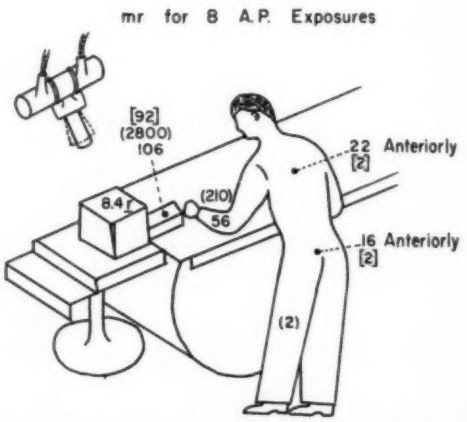

Fig. 14. Stray radiation, in mr, received by neurosurgeon during a cerebral angiography, 8 anteroposterior exposures, small diameter cone. Numbers in parentheses for large diameter cone. Numbers in brackets for small diameter cone and hanging lead rubber protection.

control switch would permit 17 feet), to be out of line of the tube and the patient, and to put a barrier such as a wall, if possible, between the patient and himself. There was another practice, resorted to for expediency, in which the technician held the film and aimed the x-rays toward himself. It was found that with a little ingenuity these films could be supported mechanically. Under no conditions was a technician allowed to hold the film. After these corrections in procedure were observed, a technician was measured on the

job. He had received no radiation measurable by pocket dosimeters placed on the right shoulder, the left shoulder, the left side of the waist, and the right leg.

A technician was monitored by pocket dosimeters and film badges while using a portable x-ray machine in the operating room during a hip-pinning operation. He observed as much care as possible under the conditions. Twelve films were taken in all. The right arm received 16 mr, the left arm 25 mr, the left side of the waist 5 mr, and the right leg 0. The values for film badges placed in approximately the same positions were as follows: right shoulder, 0; left shoulder, 50 mr; chest, 5 mr; leg, 0. This amount of stray is not excessive, since hip-pinning is only an occasional operation in our institution, but in an orthopedic hospital it could be excessive. In fact, the orthopedist probably needs monitoring more than the technician.

PART II: SPECIAL PROCEDURES

In our department various special procedures which are relatively new are being done. These were monitored by an area survey and a personnel survey.

Myelography

Since myelography is a frequent procedure in our department, an area survey was made of room 6 during a myelographic study. The conditions of examination were an enclosed table, 88 kv., 4.5 ma., h.v.l. 4.5 mm. Al, output 6.8 r/min. at the table top. The results of the survey, in mr/hr., are shown in Figure 9 for the various positions around the table.

A personnel survey was made with the radiologist and the neurosurgeon wearing pocket dosimeters on various parts of the body. The average values for the different radiologists are given in mr/min. in Figure 10. The mr/min. received on the forearms are higher in myelography than in routine work. The values in brackets are those obtained from an area survey during one particular procedure. The order of magnitude is the same. The figures for the area survey are lower. This

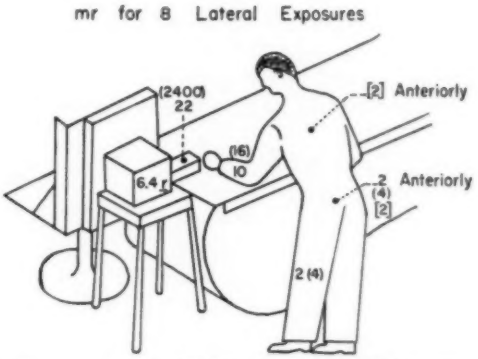

Fig. 15. Stray radiation, in mr, received by neurosurgeon during a cerebral angiography, 8 lateral exposures, small diameter cone. Numbers in parentheses for large diameter cone. Numbers in brackets for small diameter cone and hanging lead rubber protection.

is to be expected because the pocket dosimeters record exposure not only during fluoroscopy but also during spot filming. The average time for a myelographic study was 8.2 minutes. The exposure for this time is given in Figure 11 in mr.

The exposure of the neurosurgeon, who stands opposite the radiologist, is given in Figure 12 in mr/min. and in Figure 13 in mr for an average myelography of 8.2 min. The neurosurgeon received more on his face because he observed from the side and not from above the screen.

Cerebral Angiography

A Fairchild camera was used for cerebral angiography. The conditions of operation were 75 to 85 kv., 200 ma., 1/6 to 1/5 sec. exposure, 12 to 30 films per series. A lead-rubber sheet, 1 mm. lead equivalent, hung between the head of the patient and the neurosurgeon. The neurosurgeon was monitored by pocket dosimeters on the forehead, the left shoulder, which was nearest to the x-ray machine, the right and left forearm, and the left leg. The largest amount of stray radiation received was 17 mr on the left shoulder. The average of the readings for the rest of the body was about 3 mr. In the case of one neurosurgeon, however, who kept his hands at the neck of the patient during injection of the dye, it was noticed that the hands were in the direct beam for anteroposterior films. Later phantom measure-

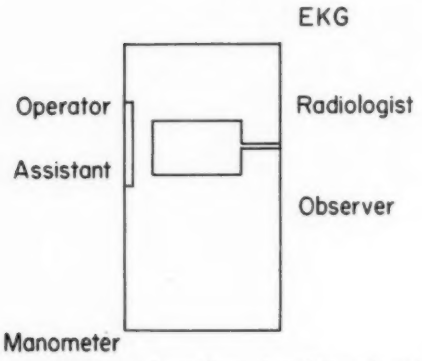

Fig. 16. Positions of members of cardiac catheterization team.

ments showed that the hands received 2,800 mr or 2.8 r for 8 anteroposterior films. When cone B, which gave a 9 1/2-inch diameter field at the head, was substituted for cone A, which gave a 14-inch field, the amount of radiation received was reduced to about 100 mr for the 8 anteroposterior exposures. The technic of injecting contrast material through a small rubber tube so that there is no chance of the hands being in the field of the direct beam would seem better so far as protection is concerned.

The stray radiation during head angiography was measured with the wax phantom and a sandbag for the neck, using cone A and then cone B with no lead rubber protection for the anteroposterior and lateral positions. The results for 8 anteroposterior exposures are shown in Figure 14. The figures in parentheses are for the large cone A, while the figures in brackets are for the small cone B with a hanging lead rubber protection. The exposures for 8 lateral films are shown in Figure 15. If a small cone B is used, the procedure is safe without any additional lead rubber. Lead rubber should be used, however, as an added precaution. This protection is necessary if the beam is angled toward the neurosurgeon, as is sometimes the case for the anteroposterior films. The stray on the same side of the hanging lead rubber as the patient's head, and in approximately the position of the operator's left shoulder but nearer to the tube, is as high as 350 mr for 8 exposures if cone A is used. In this case the lead rubber not only absorbs the x-rays but serves as a barrier to keep the operator outside the field of high stray radiation intensity.

Inside the lead rubber gloves the hands of the technician who held the head of the patient received from 2 to 36 mr for a single series. The head of the technician received 9 mr.

The patient or phantom received 8.4 r during 8 anteroposterior exposures and 6.4 r during 8 lateral exposures, approximately 1 r per exposure.

The only way to know whether the procedure is safe is to measure the radiation received in various positions under the actual conditions of operation for the individual neurosurgeon.

Cardiac Catheterization

The result of an area survey during cardiac catheterization is given in Table I,

TABLE I: MILLIROENTGENS PER HOUR RECEIVED BY PERSONNEL DURING A CARDIAC CATHETERIZATION IN ROOM 3

(Completely enclosed tube, 83 kv., 4 ma., 3 mm. Al added filter, 3 r/min output)

	Face	Waist	Hand or Forearm	Feet
Operator	5–10	12	150–200	2
Anesthetist	15	..	30–50	...
Nurse	..	..	50	...
Radiologist	..	50	...	...
E.K.G. Operator	3	..	...	...
Manometer Operator	3	..	...	...

showing what each member of the team received in mr/hr. The conditions of operation in room 3 were an enclosed table, 83 kv., 4 ma., 3 mm. Al added filter, output 3 r/min. For a 12-minute running time the dosimeter placed on the operator's forearm measured 33 mr, and a dosimeter strapped to the ankle measured 1 mr. This is in good agreement with the calculation from the area survey.

During another cardiac catheterization in the same room, under the same conditions of operation, for a 20-minute exposure, the right wrist received 20 mr and the left wrist 51 mr.

An area survey was made with a presdwood phantom on another fluoroscopic machine where most of the cardiac catheterization was done. (See Figure 16 for the position of the personnel.) The conditions of radiation were an enclosed table with 10-inch-wide slit, kilovoltage not known, output at table 4.6 r/min. The results of this survey are given in Table II.

TABLE II: MILLIROENTGENS PER HOUR MEASURED WITH A PRESDWOOD PHANTOM SIMULATING A CARDIAC CATHETERIZATION

(Large field, 8 × 8 in., room S1, 4.6 r/min. output)

		Face	Waist	Forearm	Feet
Directly above screen	4–6	...	...	...	..
Operator	...	50	220	30–70	2
Operator with lead rubber apron	...	50	2	30–70	2
Assistant	...	60	300	...	10
Manometer Operator	...	80	...	...	2
E.K.G. Operator	...	25	25	10	1
Radiologist	...	40–90	70	...	1
Observer	...	55	70	...	2

Angiocardiography

Angiocardiography was done with a Fairchild camera with voltage ranging from 76 to 95 kv., 400 ma., exposure time 1/12 to 1/20 sec., number of exposures 16 to 35. A lead-rubber sheet with a cutout for the arm hung between the individual doing the injection and the patient. When cone A was used, giving a field 16 inches in diameter on the top of the camera, the greatest stray was obtained. The largest amount with this set-up was 95 mr on the right forearm for one case, 74 mr on the right shoulder in another case. The average exposure on the forearm was approximately 20 mr per series. When cone B was used, producing a field 11 inches in diameter on the top of the camera, the stray without the lead rubber protection was less than it had been before with the protection. The largest amount for one case was 34 mr on the forearm. The average was 5 mr. The anesthetist received a negligible amount. An additional danger with a large field is that if the tube is angled even slightly toward the operator, the lead shielding of the Fairchild camera does not block the direct beam, and the legs of the operator are irradiated by this beam. This occurred in one case.

If the tube housing is designed according to paragraph 1.29 of Handbook 41 of the National Bureau of Standards (9), then the stray radiation received during a series of angiocardiograms of from 15 to 30 exposures, taken with a Fairchild camera, is small even without additional protection, provided the direct beam is coned down to give a field which can be blocked completely by the lead of the camera.

DISCUSSION

The survey meters in this study were calibrated with a radium standard. When the Geiger counter survey meter is used in the diagnostic voltage region, however, it reads too high according to curves put out by the Radiation Division of the National Bureau of Standards (4), the correction factor varying from 0.4 to 0.8 according to voltage.

Keleket pocket dosimeters also read too high according to curves from the National Bureau of Standards, the correction factor here varying from 0.67 to 0.9. The pocket dosimeters used were calibrated against a Victoreen 0.25 r ionization chamber for x-rays of 100 kv., h.v.l. 1.98 mm. Al. The correction factor for two of them was 0.7; for one it was 0.82; for another, 1.0, the same reading as the Victoreen. This dosimeter is noted as dosimeter D. The uncorrected measurements may be too high for these dosimeters by as much as 40 per cent.

Although all of these dosimeters may be correct in the gamma ray region, for which they were calibrated, their readings may differ from one another in the diagnostic x-ray region. Each instrument should be calibrated in the region in which it is to be used. Even with this precaution, the stray radiation may have a greater spread in effective wave lengths than the direct beam used in calibration. That stray radiation which is received without being absorbed by very much matter will have a longer

effective wave length, and that which is received after being absorbed by a certain thickness of matter may have a shorter effective wave length and be more penetrating. Therefore, calibration of the instrument by the direct beam may not hold precisely for the scattered beam.

The values obtained by an area survey with the ionization chamber instrument are of the same order of magnitude as were those obtained with the pocket dosimeter, as is seen in Figure 10.

Film badges, because of the selective absorption of the silver, are more sensitive in the diagnostic x-ray region than in the gamma region. The number of roentgens to give the same degree of blackening for one type of film (30) may vary from 0.05 r in the 100-kv. peak x-ray region to 1.0 r in the gamma ray region.

The Atomic Energy Commission film badges and ring films are calibrated with gamma rays, and therefore their readings were too high for the x-ray region in which these films were used.

Two film badges and two ring films from each batch were exposed, together with the pocket dosimeter D, to 100-kv. x-rays, h.v.l. 1.98 mm. Al. The ratios of reported mr for the open window on these badges to that measured with dosimeter D for different batches varied from 8 to 12. This gives a maximum variation of 50 per cent. For the ring films the ratio of the reported mr under the open window to the mr on dosimeter D varied from 8.4 to 9.2. This is in good agreement.

When Tracerlab x-ray badges were compared with dosimeter D, the mr reported on the badges were lower than the number measured on the dosimeter. The ratios of the mr on dosimeter D to the mr of the badge varied from 1.25 to 1.75, a maximum variation of about 40 per cent.

Thus it is seen that stray radiation measurements, because of wave length or energy dependence, do not have a high degree of accuracy. The accuracy is greater if these instruments and badges are calibrated against a standard in the region in which they are to be used. The readings in this x-ray region of most pocket dosimeters and survey meters on the market are higher than the standard and therefore the error is on the safe side. However, even with this poor accuracy, the measurements serve a useful purpose. It is important to know that one is getting about 30 mr/wk. instead of about 300 mr/wk. It would be more instructive to know that one is getting 298 instead of 300, but that is not possible with our present methods of measurement.

If all x-ray tubes had protective tube housings, as required in paragraph 1.29 of Handbook 41 of the National Bureau of Standards, *i.e.*, "0.10 r per hour at a distance of one meter from the tube target when the tube is operating continuously at the maximum rated current for the maximum rated voltage," then the problem of protection would be confined to stray radiation and would be relatively simple. Since, however, larger amounts than this do get through, as in the opening of the table where the Bucky slides, and in some cases through certain sections of the housing, and since all tubes are not properly housed, it is important to survey each installation.

A tube housing is designed for a certain maximum kilovoltage. If these tubes are used with higher voltages, then the direct radiation other than the useful beam coming through the now inadequate tube housing may be much higher than it was for the kilovoltage for which the tube was designed. The radiation which the patient receives when the kilovoltage and filtration are increased may be less, but with improperly housed tubes the radiation which the radiologist receives may be much higher even though that scattered from the patient is less.

Each radiologist or physician using the fluoroscope should be observed under the conditions in which he works. A change of position may decrease the amount of stray radiation to which he is subjected. This is especially true for observers.

The stray radiation received during spot filming is not high. Phantom measurements indicate that the stray from four spot films would be equivalent to that from

one minute of fluoroscopy. In our department each fluoroscopist takes from 10 to 40 spot films a day, yet in no case was the stray radiation higher than 65 mr/wk. on the most exposed part of the body. Therefore, with our set-up, spot filming does not offer any particular stray radiation problem.

In order to avoid using defective or torn lead rubber aprons or gloves, a regular inspection period should be instituted in which either one person examines all the equipment used or each individual inspects his own protective devices. All defective aprons and gloves should be removed so that they cannot by mistake go into circulation again.

With the exception of the exposure obtained during the taking of portable films, technicians who have been instructed to stay away from open doors and not to hold patients or films should get very little stray radiation in a properly protected department. However, if only a "token" wall surrounds the x-ray equipment, as is sometimes the case in private offices, a technician may be receiving an exposure beyond the permissible 300 mr/wk. The average stray radiation of the technician staff in this investigation was about 10 mr/wk. as measured with film badges.

The highest stray radiation for the radiologist was 65 mr/wk. in the region of the arm and of the ankles, and less in other parts of the body. It is believed that this can be brought down to about half the maximum or less than 30 mr/wk. According to Sievert (23), a safety tolerance dose of 10 mr per day should not be exceeded.

The film badge should be worn on the most exposed portion of the body. If worn on the lapel, it is behind the fluorescent screen, where it receives the least amount of radiation.

It has been noted by other investigators (11, 12), also, that the operator who wears a film badge or a pocket dosimeter is cognizant of stray radiation and makes an effort to keep this as low as possible. Monitoring then, in addition to being a means of measuring the stray radiation, becomes a means of decreasing the stray radiation received by the personnel.

SUMMARY

1. The need for monitoring a diagnostic x-ray department is discussed.

2. A system of monitoring is outlined consisting of the measurement (*a*) of the output of each fluoroscope, (*b*) of the h.v.l. of each fluoroscope, (*c*) of the stray radiation, by means of an area survey with an ionization type survey instrument, (*d*) of the stray radiation received by the personnel, as determined by pocket dosimeters, film badges, and ring films.

3. The results of these measurements are given in schematic diagrams in mr/hr. for the area survey and in mr/min. and mr/wk. for the personnel surveys.

4. Measurements on a phantom, showing that the exposure due to 4 spot films corresponds to an exposure of approximately one minute of fluoroscopy, are presented.

5. The results of measurement for special procedures, such as myelography cerebral angiography, angiocardiography, and cardiac catheterization, are given in schematic diagrams and tables.

6. The need for calibration of the instruments and badges in the x-ray region in which they are used is discussed.

7. The order of magnitude of the accuracy obtainable by these measurements is presented. Variations up to 40 per cent are found. Despite such variations, the measurement of stray radiation in the protection of personnel is urged.

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SUMARIO

Fiscalización de un Departamento de Rayos X para Diagnóstico

La fiscalización cuidadosa y continua para determinar la cantidad de radiación directa y dispersa a la que está expuesto el personal reviste tanta importancia en los procedimientos de diagnóstico como en la radioterapia.

El plan de fiscalización descrito en este trabajo es el vigente en el Hospital Montefiore, de Nueva York. Comprende: medición de la emisión de cada roentgenoscopio; medición de la capa de hemirreducción para cada roentgenoscopio a fin de determinar la calidad de la irradiación; inspección de la zona con un medidor provisto de cámara de yonización; y estudio del personal con la ayuda de dosímetros de bolsillo, y películas indicadoras corrientes y en forma de anillos. Ejecutáronse mediciones tanto para la fluoroscopia y la radiografía corrientes como para procedimientos tan especializados como son la mielografía, la angiografía cerebral, la angiocardiografía y el cateterismo cardíaco.

Debido al largo de onda o la relación con la energía, las mediciones de la irradiación dispersa no poseen mayor exactitud. No obstante, ésta es mayor si se calibran los instrumentos y divisas de medición con una pauta en la región en que van a usarse.

A pesar de las variaciones en la exactitud, que pueden llegar a 40 por ciento, la medición de los rayos dispersos cumple un propósito importante en la protección del personal.

EDITORIAL

Radiologic Examination of the Obstetric Patient

One of our late foremost contemporary expositors of scientific subjects, Sir Arthur Eddington, wrote:

> Whether we are studying a material object, a magnetic field, a geometrical figure, or a duration of time, our scientific information is summed up in measures.

The science of radiology was born in a physics laboratory. It has been nurtured, guided, and disciplined by wise and sympathetic physicists working in collaboration with physicians. It is not surprising that our colleagues in obstetrics might have asked a reasonable exactitude of measurement in the application of radiology to pelvimetry and fetal cephalometry. The surprise is that the clinician did not seem to appreciate properly what the physicist, not the biometrician, considers to be the coefficient of correlation.

The act of parturition is the dramatic climax of an event about forty weeks in the making. Nevertheless, its occurrence sometimes engenders an atmosphere of emergency. One reason for concern at this time is that the greatest hazard to the mother or to the fetus during gestation is present during the actual passage of the fetus through the birth canal.

Knowledge of the spatial relationship between the size of the fetal head and the bony birth canal is of primary importance to avoid certain dangers. Technics of evaluating this relationship are acquired by physicians through observation and clinical experience. It is doubtful that all skillful obstetricians are aware of the factors they utilize in their evaluation. No doubt it extends beyond a simple mass relationship to include, for example, pliability of the pelvic floor and anticipated uterine force. The lack of appreciation of the effects of some factors and inability to place them in their proper relationship have resulted in underestimating or overestimating assistance obtained from roentgenographic pelvimetry and fetal cephalometry.

Technics for the roentgenographic examination of the obstetrical patient have been influenced by capacity of x-ray machines and physical arrangement of equipment, preconceived concepts of the mechanism of labor, inability to reconstruct a three-dimensional object from right-angle views, overemphasis on a single feature of the problem, shyness in attempt to calculate divergent ray distortion, etc. The great variety and number of methods described in the literature reflect the authors' background training or particular interest in one phase of the problem rather than deficiencies in previously described technics of roentgenographic mensuration. The roentgenologic examination of the obstetrical patient should be an individualized procedure aimed at answering the particular problem which arises at any time during the period of gestation. In actual practice, that is about what it has been and will continue to be. The clinical significance of certain observations not appreciated previously and the importance of modifying the examination to emphasize these observations are, of course, common to advancement in all the branches of medical science.

It might be maintained by some that the practice of good medicine and obstetrics is an art, and not necessarily based on scientific information which involves too much measurement. It would be impractical to approach the patient in a manner which might suggest to her that she had consulted a physical anthropometrist rather than a physician. Nevertheless, a patient is evaluated by a comparison with some standard regardless of awareness of the unit of meas-

ure. In most instances the fetal head can be compared with the maternal bony pelvis by inspection alone when roentgenograms are taken with the pregnant woman standing erect, thereby taking advantage of gravity pulling the heavier object in the amniotic cavity into its most dependent portion. This will place the fetal head, or breech, in the midsagittal and midcoronal planes of the pelvis normally, and the comparison is reliable because magnification due to divergent rays will affect both the engaged fetal head and maternal bony pelvis to about the same degree.

To the average physician, who attends the great majority of women in parturition in this country, anteroposterior and lateral roentgenograms of the pelvis and lower abdomen taken with the patient erect near term are quite informative. They disclose the pertinent concern of the moment, the approximate relationship of a particular passenger to the passage, without further ado. To the student and to those with intellectual curiosity, it has seemed desirable to establish a more exact quantitative relationship which could be expressed in units of measure. The basic step in practically all of these lines of approach has been to develop a procedure which reduces the dimensions of the roentgenographic image to unity. At this point the study usually comes to an end. A few industrious workers have done studies of correlation on the progress, duration, and the outcome of labor with pelvic dimensions. Included in such studies are multiples of dimensions (diameters) in the same or different planes, summation or other combinations, and various indices. Pelves showing a certain pattern of distribution of relative dimensions have been classified into groups and a study of correlation done. The net result of these worthwhile and commendable investigations will, no doubt, be a valuable contribution to the measurement of man in the mass.

Radiologists will retain the confidence of their colleagues in obstetrics by producing good quality roentgenograms which permit objective study, and a method of comparison that will alert the clinician to the existence of a borderline or true disproportion. Prognostications on the duration and outcome of labor might well be left to the esoteric. ROBERT P. BALL, M.D.

New Appointments to the Editorial Staff

As the field of radiologic research broadens and new aspects of the specialty must be critically considered in relation to publication in RADIOLOGY, the editorial staff has found itself confronted by additional problems and responsibilities. In recognition of this situation and with the desire to draw inspiration and advice from representatives of the younger group of radiologists, the Publication Committee has made two important appointments, a third associate editor of RADIOLOGY and a fourth member of the Advisory Editorial Board.

The new Associate Editor is Dr. Laurence L. Robbins, of Boston, Massachusetts, who will be concerned with problems of both diagnosis and therapy. Dr. Robbins is Radiologist-in-Chief of the Massachusetts General Hospital, and is Assistant Professor of Radiology in the Harvard Medical School. He has been a frequent and valuable contributor to the current medical literature during recent years and is coauthor, with Dr. George W. Holmes, of *Roentgen Interpretation*.

Dr. Richard H. Chamberlain, who has been appointed to the Advisory Editorial Board, is an associate in the Department of Radiology of the Hospital of the University of Pennsylvania and Associate Professor of Radiology in the Medical School of the University of Pennsylvania and in the Graduate School of that institution. As a member of the Advisory Board he will deal particularly with nuclear medicine.

RADIOLOGY and the Radiological Society are fortunate to have secured the services of these two outstanding radiologists.

ANNOUNCEMENTS AND BOOK REVIEWS

SEVENTH INTERNATIONAL CONGRESS OF RADIOLOGY

Arrangements for the forthcoming Seventh International Congress of Radiology to be held in Copenhagen, Denmark, July 19–25, 1953, are well in hand, and it is hoped to circulate the Preliminary Program during the spring. Copies will be sent to all members of national radiological societies, from most of which membership lists have already been received.

It will be greatly appreciated if as many potential members as possible enroll well in advance of the official closing date. This will enable applications to be dealt with more promptly.

The address of the Congress Office is: Seventh International Congress of Radiology, Øster Volgade 10, Copenhagen K, Denmark.

In conjunction with the Congress there is being arranged an International Exhibition of X-Ray Equipment and Accessories to be held in Forum Exhibition Hall, Copenhagen, July 20–24. A large number of firms have been invited to make provisional applications for space. Any firms not having received information or requiring further details should apply to the Technical Exhibition Committee at the address given above.

AMERICAN RADIUM SOCIETY

The American Radium Society will hold its annual meeting June 8–10, 1952, at the Conrad Hilton Hotel, Chicago. Dr. Hugh F. Hare will deliver the Presidential Address on Monday morning, June 9. The Janeway lecture will be given at 4:30 on Monday by Dr. Arthur Purdy Stout, of New York, who will take as his subject "Intraepithelial Carcinoma of the Larynx."

AMERICAN COLLEGE OF RADIOLOGY

At the annual meeting of the American College of Radiology in Chicago, on Feb. 8, the following officers were elected: Dr. John S. Bouslog, Denver, President; Dr. Robert P. Ball, Baton Rouge, La., Vice-President; Dr. John D. Camp, Los Angeles, Chairman of the Board of Chancellors, and Dr. Earl E. Barth, Chicago, Treasurer. At the annual banquet the Gold Medal of the College was awarded to Dr. George E. Pfahler of Philadelphia for "distinguished and extraordinary service to the college and to the profession for which it stands."

PENNSYLVANIA RADIOLOGICAL SOCIETY

The Pennsylvania Radiological Society will hold its Annual Meeting at Bedford Springs Hotel, Bedford, Penna., May 16 and 17. The following program has been arranged.

Friday, May 16

9:00 Registration
9:30 Film-Reading Session, Paul Bovard, M.D.
11:00 The Structure of the A. M. A., Francis F. Borzel, M.D.
11:30 Subacromial Bursitis, Wm. J. Corcoran, M.D.
11:50 Major Operative Procedures Following Intensive Irradiation in the Management of Oral Carcinoma, S. Gordon Castigliano, M.D.
12:20 Discussion
2:00 Periampullary Lesions, Philip J. Hodes, M.D.
2:20 Foreign Bodies in the Esophagus, Charles L. Hinkel, M.D.
2:40 Torsion of the Stomach (Case Presentation) Emil A. Kratzman, M.D.
3:00 Discussion
3:15 Pulmonary Function Obtained by Radiological Methods, Robert P. Barden, M.D.
3:35 The Thymus, J. T. Littleton, M.D. (by invitation)
3:55 Discussion
4:15 Business Meeting

Saturday, May 17

9:30 Film Reading Session, Paul S. Friedman, M.D.
11:00 Cervical Discs, George W. Chamberlin, M.D.
11:20 Discussion
11:30 Renal Tumors, Carl B. Lechner, M.D.
11:50 Discussion
12:00 Pelvimetry, Joseph J. O'Brien, M.D.
12:20 Discussion
12:30 Useful Patterns in Trifocal Glasses, D. Alan Sampson, M.D.
12:45 Discussion, opened by Paul Bovard, M.D.
2:00 Care of the Cancer Patient, John H. Lazzari, M.D.
3:00 Business Meeting

RADIATION THERAPY ALUMNI ASSOCIATION, BELLEVUE HOSPITAL

The annual meeting of the Bellevue Hospital Radiation Therapy Alumni Association will be held on Thursday, May 8, 1952, at 1:00 P.M. in the Eighth Floor Lecture Hall of the Administration Building at Bellevue Hospital (New York).

The program will feature the annual Ira I. Kaplan Lecture, the guest speaker being Dr. James A. Corscaden, who will speak on "The Treatment of Carcinoma of the Uterus."

Members of the medical profession are invited.

NEW PUBLICATIONS NATIONAL BUREAU OF STANDARDS

Attention is called here to three new publications of the National Bureau of Standards of interest to radiologists.

Handbook 48: Control and Removal of Radioactive Contamination was prepared by the Subcommittee on Waste Disposal and Decontamination as part of the program of the National Committee on Radiation Protection. In addition to including a number of general safety precautions, the Handbook contains specific recommendations and discussions intended primarily for the guidance of such users of radioactive isotopes as universities, hospitals, and industrial concerns. Wherever practical, recommendations are presented separately for different groups of isotopes.

Handbook 49: Recommendations for Waste Disposal of Phosphorus-32 and Iodine-131 for Medical Users was also prepared by the Subcommittee on Waste Disposal and Decontamination. In the expectation that disposal of the greater part of phosphorus[32] and iodine[131] isotopes will be by sewer, the Handbook considers permissible concentrations from the point of view of safety to the general community and more especially to sanitation workers and sewage plant personnel. It contains practical and easily followed rules of disposal practice for the specified isotopes.

National Bureau of Standards Circular 507, on *X-Ray Calibration of Radiation Survey Meters, Pocket Chambers, and Dosimeters*, presents the results of a study by the Atomic Energy Commission undertaken as a part of the general program of standardization of the Bureau of Standards. The primary objective was to determine correction factors of detectors for various qualities of radiation. This was accomplished by observing their readings in beams for which exposure rates were established by standard chambers for various applied x-ray tube potentials and beam filtrations. Of secondary concern was the observation of details relating to the durability of the instruments and the reproducibility of results.

These three publications may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. The price of Handbook 49 is 10 cents, of Handbook 48 and Circular 507, 15 cents each. Foreign remittances must be in U. S. exchange and should include an additional one-third of the publication price to cover mailing costs.

CENTRE ANTOINE BÉCLÈRE DES RELATIONS INTERNATIONALES EN RADIOLOGIE MÉDICALE

Dr. Edwin C. Ernst has kindly shared with us a letter recently received from Mlle. Béclère, daughter of the late Antoine Béclère, describing the work of the Centre Antoine Béclère des Relations Internationales en Radiologie Médicale. The Centre is open for information each day, a library and radiological museum are beng organized, and plans are being made for the accommodation of foreign radiologists who wish to work with French physicians in various fields. An arrangement is proposed whereby any radiological organization may enroll as a Titular Member for a yearly fee which entitles it to recommend a radiologist for a three-month stay in Paris as a guest of the Centre without charge for lodging and breakfast.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

POST-GRADUATE LECTURES ON ORTHOPEDIC DIAGNOSIS AND INDICATIONS. By ARTHUR STEINDLER, M.D., F.A.C.S., Professor of Orthopedic Surgery, State University of Iowa, Iowa City, Iowa. Volume III. Section A. Tuberculosis of the Skeletal System. Section B. Osteomyelitis. A volume of 284 pages, with 255 figures. Published by Charles C Thomas, Springfield, Ill., 1952. Price $8.75.

Book Reviews

ROENTGEN EXAMINATIONS IN ACUTE ABDOMINAL DISEASES. By J. FRIMANN-DAHL, M.D., Ph.D., Chief of Roentgen Department, Ulleval Hospital, Oslo, Norway. A volume of 324 pages, with 305 figures. Published by Charles C Thomas, Springfield, Ill. Price $10.50.

The problem of prompt and accurate diagnosis of acute abdominal crises is an ever present one. This volume on the roentgen diagnosis of these cases is a most welcome one. The author has brought together most of the available information on the subject and presents it in masterly fashion. Beginning with the technic of the routine roentgen examination, he continues with a chapter describing the normal anatomy of the region and follows this with a chapter on general pathological conditions, with reference especially to intestinal gas, fluid in the intestine, pneumoperitoneum, free fluid, and associated lesions in the chest.

The fourth chapter comprises the bulk of the text, taking up the discussion of special pathological changes. Among the many specific conditions covered are the various mechanical obstructions of the small bowel and colon, hernias, intussusceptions, volvulus of various areas, mesenteric thrombosis, paralytic ileus, inflammatory lesions of the digestive tract, perforated ulcers, and peritonitis. In addition, there are sections devoted to gynecological lesions

and lesions of the urinary tract, and one to ruptures of viscera from abdominal trauma.

A wealth of information from the author's experience and that of others is presented in a logical and practical manner. The text is illustrated with more than 300 roentgenograms and sketches to bring out the points which are described. A list of general references is supplied and there are both author and subject indexes.

This volume should attract the interest of all radiologists as well as surgeons, interns, and students.

THE MERCK INDEX OF CHEMICALS AND DRUGS. AN ENCYCLOPEDIA FOR THE CHEMIST, PHARMACIST PHYSICIAN, AND ALLIED PROFESSIONS. A volume of 1,168 pages. Published by Merck & Co., Inc., Rahway, N. J., 6th ed., 1952. Price $7.50 for the regular edition; $8.00 with thumb index.

The Sixth Edition of the Merck Index of Chemicals and Drugs promises to fulfill the hope of the publishers, who dedicate it to those who have worked for the advancement of Chemistry, Pharmacy, and Medicine and to those whose lives are devoted to these sciences, "with the sincere wish. . . .that it may often be of assistance." Not only does it contain more than 8,000 descriptions of individual chemicals and drugs, many of them accompanied by structural formulae, but there are added numerous tables for ready reference, including a Periodic Chart of the Elements and the International Atomic Weights, which appear as end papers. A new feature of the Sixth Edition which will be of interest to the radiologist is the Table of Radioactive Isotopes, based on Circular 499 of the National Bureau of Standards and presenting concisely data on the half life, modes of disintegration, and energies of the radiations in mev. A second table covers the isotopes used in therapy and diagnosis with specifications as to the nuclear properties, mode of administration, and dosage.

The book is well printed in readable type arranged in double column, and is attractively bound. Its place on the doctor's reference shelf should be close to his medical dictionary and current indexes to the literature.

LA SPONDYLARTHRITE ANKYLOSANTE. CLINIQUE, RADIOLOGIE, ANATOMIE PATHOLOGIQUE, TRAITEMENT. By J. FORESTIER, Aix-les-Bains, F. JACQUELINE, Aix-les-Bains, and J. ROTES-QUEROL, Barcelona. A volume of 330 pages, with 143 figures. Published by Masson & Cie, Paris, 1951. Price 2650 fr.

Ankylosing spondylitis, which in the English-speaking world has generally been known as rheumatoid spondylitis, has been the subject of an extensive literature, but nearly all of this is in the form of articles or limited monographs. Until now no one has ventured to prepare a comprehensive treatise. The present volume, which has been written in collaboration by Forestier, Jacqueline, and Rotes-Querol, represents an attempt to supply this deficiency. The book, which is well printed and bound in heavy paper, is divided into 16 chapters covering: (1) History of the Disease; (2) Frequency; (3) General Considerations; (4) Spinal and Paraspinal Symptoms; (5) Radiating Pain; (6) Involvement of Peripheral Joints; (7) Ocular Manifestations; (8) Laboratory Examinations or Tests; (9) Modes of Onset; (10) Modes of Evolution; (11) Clinical Forms; (12) Diagnostic Problems and Rules to Be Followed; (13) Etiology; (14) Pathology; (15) Pathogenesis; (16) Treatment.

The text is based primarily on a personal study of 400 cases, but it takes into consideration, also, the observations and findings of other workers. One valuable feature is that it is well illustrated with many excellent and well chosen roentgenograms, diagrams, and photographs of actual cases, showing different stages and phases of the condition. The authors do not claim that their work represents the last word on the subject, but their conservative attitude and the care and thoroughness with which their cases have been studied from every possible angle cannot but impress the reader favorably. There is no doubt that this work will help to clarify a subject which, until now, has been something of a puzzle. For this reason, if for no other, it deserves well of the medical profession. It is considerably enhanced by an extensive bibliography and a good index.

Physicians who have to deal with rheumatoid arthritis of the spine will find in this work not only an up-to-date presentation of the medical evidence bearing on the disease but also valuable observations which the authors themselves have made, which may prove of considerable importance.

LA MALATTIA SCLERODERMICA. By GUIDO BASSI. With a preface by PROF. GIOVANNI DI GUGLIELMO. A volume of 702 pages, with 185 figures. Istituto Editoriale Medico, Bologna, 1951.

This work is based on the study of 50 cases of scleroderma, and the author considers at length the many aspects of this disease with special regard to its pathogenesis and to its association with other conditions. The references to radiological symptoms of the disease are scattered throughout the book. They may be summarized as follows: shortening of the fingers and toes due to reabsorption of the ungual tufts and of the shafts of the last phalanges, periarticular cystic formation, osteoporosis of the calvarium, soft tissue calcifications including digital concretions, periarticular and subcutaneous calcifications. The visceral involvement is practically limited to the esophagus, which shows dilatation and lack of peristalsis.

This book represents a voluminous compilation of literature, to which the author has added his own experience. Brevity would have enhanced the value of this work.

IN MEMORIAM

JAMES PHILIP KERBY, M.D.

1886–1952

Dr. James Philip Kerby, one of the pioneer radiologists of the Rocky Moutain region, died at his home in Salt Lake City, Utah, on Jan. 26, 1952, at the age of sixty-five years. He may be considered another martyr to the science of roentgenology, in that his death was due to complications following a radical amputation of the right arm necessitated by metastasis from malignant degeneration of irradiation lesions of the fingers.

Dr. Kerby was born in Washington, D. C., a son of Charles and Kate Anne (Holleran) Kerby. He was of the eighth generation of his family in this country and on his father's side a lineal descendant of the Second Lord Baltimore, who colonized Maryland. He received his education in the public Schools of Washington, D. C., and was graduated from the Medical School of George Washington University in 1910. After serving an internship at the Central Dispensary and Emergency Hospital of Washington, and later a residency at Children's Hospital of that city, Dr. Kerby acted as Surgeon for the U. S. Reclamation Service in Utah, Montana, and Idaho during the years 1912 to 1915. He then returned to Washington, where he engaged in the private practice of medicine prior to entering the Army in 1917. He attended the School of Military Roentgenology at Johns Hopkins Hospital in 1917–18 and did active duty at Camp Greenleaf, Ga., in 1918–19. In 1919 he served as Chief Medical Officer at Fort Douglas, Utah.

In 1920 Dr. Kerby opened an office in Salt Lake City for the private practice of Radiology. He was appointed Radiologist to St. Mark's Hospital in 1921, a position which he held until his death. At various times he served, also, as Radiologist to Holy Cross Hospital, Salt Lake General Hospital, U. S. Veterans Hospital, and Primary Children's Hospital. He was an instructor in roentgen anatomy on the teaching faculty of the University of Utah Medical School from 1922 to 1944. When the School became a four-year medical school in 1943, Dr. Kerby was made an Associate Professor of Medicine in Radiology.

"Jim" Kerby, as he was known to his colleagues, will be long remembered for his persevering and untiring efforts in behalf of organized medicine. He was especially interested in elevating the standards of radiology and was deeply concerned over the problem of hospital exploitation of radiologists. He served as a member of the House of Delegates of the American Medical Association from 1945 to 1949, during which time he sponsored the resolution which led to the formation of the now famous Hess Committee. He was a Past-President of the Salt Lake County Medical Society and of the Utah State Medical Association. In 1948 he acted as President of the Rocky Mountain Radiological Society. He was a member of the American Roentgen Ray Society and was Counselor for Utah for the Radiological Society of North America. In 1949 he was a delegate to the meeting of the Inter-American Congress of Radiology at Santiago, Chile, and in 1950 to the International Congress of Radiology in London and to the meeting of the International Cancer Society in Paris. He was a charter member and Past-President of the Utah State Radiological Society.

Dr. Kerby is survived by a son, James Philip Kerby, Jr., and a grandson James Philip Kerby III.

"Jim" Kerby was known for his ready wit, for his sound counsel, and for his tenacity and vigor in fighting for what he believed to be right. In his passing, organized medicine, and radiology in particular, have lost a valiant champion. He will be greatly missed and deeply mourned by his many colleagues and friends.

M. Lowry Allen, M.D.

ISAAC GERBER, M.D.

1885–1952

After an illness whose beginning dates back thirty years, Dr. Isaac Gerber of Pawtucket, R. I., died on Feb. 17, 1952.

Dr. Gerber was born in Boston on May 11, 1885, the son of Jacob and Ida Gerber. He was graduated from Harvard University in 1907 and from Harvard Medical School in 1910. After an internship in the Boston City Hospital, he continued his studies abroad, at the University of Tübingen and in Berlin and Vienna. Although his original intention had been to devote himself to internal medicine, Dr. Gerber's interest in radiology was early aroused and on his return to America, in 1913, he established himself as a specialist in that field, becoming one of the pioneer radiologists of Providence, R. I.

In spite of a disease affecting his lower spine and extremities, which necessitated the use of crutches and eventually a wheel chair, Dr. Gerber achieved a notable career as a radiologist. He was at one time head of the X-ray Department of Rhode Island Hospital and served as consulting radiologist to a long list of hospitals, including the Rhode Island, St. Joseph's, Charles V. Chapin, Providence Lyingin, Butler, Miriam, Homeopathic, Woonsocket, Westerly, and South County. He was a diplomate of the American Board of Radiology, a fellow of the American College of Physicians and the American College of Radiology, and a member of the New England Roentgen Ray Society (President 1932–33), the American Roentgen Ray Society, the American Radium Society, and the Radiological Society of North America.

A man of high intellectual attainments and varied interests, Dr. Gerber was widely read in all fields of medicine, not only in English but also in French and German. He had himself contributed numerous articles to the literature, especially in relation to gastro-intestinal diagnosis and the roentgen treatment of bronchial asthma and allied conditions.

Dr. Gerber is survived by his wife, Rose Albert Gerber, and by a daughter, Mrs. Helen G. Bloom, of Hartford, Conn.

ROBERT KERR PATERSON, M.D.

1878–1952

Dr. Robert Kerr Paterson, a pioneer in the practice of Radiology in Canada, died at his home in Ottawa on Feb. 29, 1952.

Dr. Paterson was born in Greenock, Scotland, a son of James and Mary Kerr Paterson. He came to Canada as a boy and in 1906 was graduated from Queens University with the degrees of M.D. and C.M. He continued his studies abroad and, having earned the degrees M.R.C.S. (England) and L.R.C.P. (London), returned to Canada to serve his internship in the Ottawa General Hospital. He became the first practising radiologist in Ottawa and was the first physician to make use of raduim in the province of Ontario. In 1934 Dr. Paterson became head of the Ottawa Civic Hospital, giving up his private practice to devote himself to this position, which he continued to hold until his death. He was also Director of the Ottawa Tumor Clinic.

Dr. Paterson was a diplomate of the American Board of Radiology and a member of the American College of Radiology, the American Radium Society, and the Radiological Society of North America (emeritus), the British Medical Association, and the Canadian Medical Association. He was a Past-President of the Ontario Medical Association and of the Ottawa Academy of Medicine.

In addition to his skill, Dr. Paterson brought to the practice of his profession a kindness of heart which won for him the friendship of his associates and the gratitude of his patients. He was married in 1923, in his native Scotland, to Elizabeth Holmes, who survives him. He is survived also by a son, Robert Kerr Paterson, now enrolled in Queens University, and by two daughters, Mrs. Gordon Kester of Wilmington, Del., and Miss Elizabeth Kerr Paterson.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, John E. Wirth, M.D., 635 Herkimer St., Pasadena 1, Calif.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix. Annual meeting with State Medical Association.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Sydney F. Thomas, M.D., Palo Alto Clinic, Palo Alto.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, John B. Hamilton, M.D., 210 N. Central Ave., Glendale 3. Meets monthly, second Wednesday, Los Angeles County Medical Association Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, G. A. Fricker, Sacramento Co. Hospital, Sacramento 17. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with State Medical Association.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, Rex Uncapher, M.D., 7720 Girard Ave., La Jolla. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, I. J. Miller, M.D., 2680 Ocean Ave., San Francisco 27. Meets quarterly, at the University Club.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, Ford Shepherd, M.D., 526 Soquel Ave., Santa Cruz. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Charles E. Duisenberg, M.D., Palo Alto Clinic, 300 Homer Ave., Palo Alto. Meets third Thursday at 7:45, January to June at Stanford University Hospital, July to December at San Francisco Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Wendell P. Stampfli, M.D., 1933 Pearl St., Denver. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Fred Zaff, M.D., 135 Whitney Ave., New Haven. Meets bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Ellwood W. Godfrey, M.D., 1676 Boulevard, W. Hartford. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, U. V. Wilcox, M.D., 915 19th St., N.W., Washington 6. Meets third Thursday, January, March, May, and October, at 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Nelson T. Pearson, M.D., 1109 Huntington Bldg., Miami. Meets in April and in November.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary*, Maurice Greenfield, M.D., Ingraham Bldg., Miami. Meets monthly, third Wednesday, 8:00 P.M., Veterans Administration Bldg., Miami.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Dudley King, M.D., 35 Linden Ave., N. E. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert C. Pendergrass, M.D., Americus. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton, Jr., M.D., University Hospital, Augusta.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary*, Col. Alexander O. Haff, Tripler Army Hospital, Honolulu. Meets monthly on the third Friday, at Tripler Army Hospital.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, Benjamin D. Braun, M.D., 6 N. Michigan Ave., Chicago 11. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Willard C. Smullen, M.D., St. Mary's Hospital, Decatur.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, William M. Loehr, M.D., 712 Hume-Mansur Bldg., Indianapolis 4. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary*, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Charles M. White, M.D., 3244 East Douglas, Wichita 8. Meets annually with State Medical Society.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Clark F. Miller, M.D., Central Maine General Hospital, Lewiston.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, Richard B. Hanchett, M.D., 705-6, Medical Arts Bldg., Baltimore 1. Meets third Tuesday, September to May.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, James C. Cook, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, Leo A. Nash, M.D., 572 Lowry Medical Arts Bldg., St. Paul 2. Meets in Spring and Fall.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John W. Evans, M.D., 621 High St., Jackson 2, Miss. Meets monthly, third Tuesday, at 6:30 P.M., at the Rotisserie Restaurant, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City 6, Mo. Meets last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Francis O. Trotter, Jr., M.D., 634 North Grand Blvd., St. Louis 3. Meets on fourth Wednesday, October to May.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Russell W. Blanchard, M.D., 1216 Medical Arts Bldg., Omaha. Meets fourth Thursday of each month at 6 P.M. in Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, L. L. Robbins, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday, at the Harvard Club, Boston.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene. Meets quarterly in Concord.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Nicholas G. Demy, M.D., 912 Prospect Ave., Plainfield. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway.

BROOKLYN ROENTGEN RAY SOCIETY. *Secretary*, J. Daversa, M.D., 603 Fourth Ave., Brooklyn. Meets fourth Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10. Meets in January, May, October

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meets fourth Thursday, October to May, at 8:45 P.M., Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Irving Schwartz, M.D., 45 E. 66th St., New York 21.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John F. Roach, M.D., Albany Hospital, Albany. Meets at University Club, Albany, second Wednesday, October, November, and March. Annual meeting in June.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, George Gamsu, M.D., 191 S. Goodman St. Meets at Strong Memorial Hospital, last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary*, Walter J. Brown, M.D., Northern Westchester Hospital, Mount Kisco, N. Y. Meets third Tuesday of January and October and at other times as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2. Meets in May and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, P. H. Woutat, M.D., 322 Demers Ave., Grand Forks.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Willis S. Peck, M.D., 1838 Parkwood Ave., Toledo 2. Meets with State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Frank A. Riebel, M.D., 15 W. Goodale St., Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mortimer Lubert, M.D., Heights Medical Center Bldg., Cleveland Heights 6. Meets at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary*, Lee S. Rosenberg, M.D., Jewish Hospital, Cincinnati 29. Meets first Monday, October through May.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Geo. A. Nicoll, M.D., Miami Valley Hospital, Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. E. Brown, M.D., 21st and Xanthus, Tulsa 4. Meets in October, January, and May.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Richard Raines, M.D., Medical-Dental Bldg., Portland 5. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, George P. Keefer, M.D., American Oncologic Hospital, Philadelphia 4. Meets first Thursday of each month at 8:00 P.M., from October to May, in Thomson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Edwin J. Euphrat, M.D., 3500 Fifth Ave., Pittsburgh 13. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at Webster Hall.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maurice D. Frazer, M.D., 1037 Stuart Bldg., Lincoln, Nebr.

South Carolina

SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, Henry E. Plenge, M.D., 855 N. Church St., Spartanburg. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Marianne Wallis, M.D., 1200 E. Fifth Ave., Mitchell. Meets during annual meeting of State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. *Secretary*, John E. Whiteleather, M.D., 899 Madison Ave. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. Meets monthly, third Monday, in Dallas odd months, Fort Worth even months.

HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, Frank M. Windrow, M.D., 1205 Hermann Professional Bldg.

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ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

GURDJIAN, E. S., AND WEBSTER, J. E. Cerebrovascular Accidents 597

ZAUNBAUER, W. Widening of the Septum Pellucidum 597

CAIRNS, HUGH, AND MOSBERG, WILLIAM H., JR. Colloid Cyst of the Third Ventricle 597

BELCHER, E. H., AND EVANS, H. D. Localisation of Cerebral Tumours with Radioactive Derivatives of Fluorescein 598

DEWINTER, JAN G. Preliminary Clinical Observations on Radioactive Isotopes for Localisation of Brain Tumours 598

DI CHIRO, GIOVANNI, AND LINDGREN, ERIK. Radiographic Findings in 14 Cases of Sturge-Weber Syndrome 598

FALLS, HAROLD F., ET AL. Ocular Complications in Intracranial Arteriography 598

GUSTAFSON, JACK R. Acute Parotitis 599

GLENN, JOHN C., JR., ET AL. Tumors of the Jaws 599

CAMPBELL, WILLIAM. Tumours of the Jaw 599

The Chest

ATWELL, SHERMAN W. Standardized Oblique Roentgenography of the Chest 600

PECK, MORDANT E., ET AL. Use of a Water-Soluble Agent for Bronchography 600

REINHARDT, K. Total Left Pulmonary Atelectasis after Bronchography 600

PAPANICOLAOU, B. Classification of Pulmonary Tuberculosis with Five Digit Code 600

CHAMBERS, JOHN S., JR. Tuberculous Cavities of the Lower Lobe 601

PACKARD, JOHN S. Bilateral Tuberculous Bronchostenosis with Normal Chest: Roentgenographic Findings 602

STEINBERG, ISRAEL, ET AL. Angiocardiographic Findings in Pulmonary Tuberculosis 602

SCHNEIDER, LOUIS, AND WIDELOCK, DANIEL. "Positive Sputum" Without Pulmonary Tuberculosis 602

ABBOTT, OSLER, A., ET AL. Significance and Management of Peripheral Pulmonary Masses 602

OVERHOLT, RICHARD H. The Most Detectable Internal Cancer 602

STAPLETON, J. G., AND JANES, E. C. Alveolar Cell Tumour of the Lung 603

SOLOMON, SAUL. Silicosis Among Iron Foundry Workers 603

DAUMET, PH., AND LE MELLETIER, J. Lobar Emphysema Simulating a Giant Emphysematous Bulla 603

WU, JACK F., AND NEPTUNE, WILFORD B. Pneumothorax as a Complication of Pneumoperitoneum 603

MATHEY, AND MANNES. Nodal Calcification and Serious Hemoptysis 603

BIBER, DAVID, AND BUCKLER, ARTHUR. Migratory Pneumonia Without Eosinophilia 604

DOUB, HOWARD P. Mediastinal Cysts of Embryologic Origin 604

GOULD, DAVID M. Roentgenologic Diagnosis of Congenital Cardiovascular Malformations 604

ZINN, WILLARD, J., ET AL. Effect of Angiocardiography on the Heart as Measured by Electrocardiographic Alterations 604

KJELLBERG, SVEN R., ET AL. Effect of Various Factors on the Roentgenological Determination of the Cardiac Volume 604

BÜCHNER, H. Orthodiametry 605

STUMPF, P. Contractile Dysfunction of the Heart in Kymography 605

ERNSTENE, A. CARLTON, AND HAZARD, JOHN B. Extensive Calcification of the Myocardium 605

O'FARRELL, P. T. Calcification of Left Auricle 605

The Digestive System

DÖRKEN, HORST. Scleroderma, with Involvement of the Esophagus 605

GIANTURCO, CESARE. Gastric Double Contrast 606

DUBLIN, JOHN W., AND ADY, ALBERT E. Hypertrophic Pyloric Stenosis 606

MAISEL, BERNARD, AND WEINTRAUB, SIDNEY. Prolapsing Gastric Mucosa Through Gastrojejunostomy Simulating Cancer 606

WHEELOCK, MARK C., ET AL. Gastric Polyposis. 606

JENSEN, MARSHALL N. Multiple Polyposis of the Small and Large Intestines with Multiple Intussusception 606

HUDAK, ALBERT. Accelerated Transit Through the Intestine 607

WESTDAHL, PHILIP R. Hysterical Abdominal Distention Simulating Acute Intestinal Obstruction 607

STIENNON, O. ARTHUR. Pneumatosis Intestinalis in the Newborn 607

MCCORMICK, NORMAN A. Diagnosis of Early Cancer of the Large Bowel and Rectum 607

KAHLE, H. REICHARD. Intussusception in Children Under Two Years of Age 608

POOL, R. M., AND DUNAVANT, W. DAVID. Volvulus of the Sigmoid Colon 608

LIKELY, DAVID S., AND CUTLER, CONDICT W., JR. Mucocele of the Appendix 609

SMITH, HUGH P., JR., AND RUNGE, TOM M. Oral Cholecystography 609

ZSEBÖK, Z., ET AL. Relationship Between the Excretion of Sodium Tetraiodophenolphthalein and Non-Opacification of the Gallbladder 609

ZIEROLD, ARTHUR. Operating Room Cholangiograms 610

CHRISTIE, G. S. Diaphragmatic Deformation of the Liver 610

The Musculoskeletal System

GHANTUS, MUSA K. Growth of Shaft of Human Radius and Ulna During First Two Years .. 610
FRANCIS, CARL C. Appearance of Centers of Ossification in the Human Pelvis Before Birth 610
BOWSER, JOHN F. Infantile Cortical Hyperostoses 611
RAPOPORT, LEONARD M. Infantile Cortical Hyperostoses 611
KITCHIN, IAN D. An Atypical Case of Infantile Cortical Hyperostoses 611
KNEAL, ELLSWORTH, AND SANTE, L. R. Osteopetrosis (Marble Bones) 612
BERNEY, PAUL W. Osteoporosis 612
BRAUER, W. Melorheostosis: Forme fruste 612
THOMSEN, GREGERS, AND VESTERDAL, JØRGEN. Atypical Hurler's Syndrome 613
MÜLLER, G. M., AND SISSONS, H. A. Renal Rickets Simulating "Metaphysial Dysostosis" 613
GARDELLA, GIOVANNI. Periarticular Calcifications 613
HÄUSSLER, GEORG. Indications for Contrast Visualization of Space-Occupying Processes in the Spinal Canal 613
KRÖKER, P. X-ray Examination in Lumbar Disk Prolapse by Means of Kovács Lumbo-Inguinal Projection 613
COPE, V. ZACHARY. Actinomycosis of Bone with Special Reference to Infection of the Vertebral Column 614
BRETT, M. S. Advanced Actinomycosis of the Spine Treated with Penicillin and Streptomycin 614
KASTERT, J. Tuberculostatic Treatment of Foci in Spinal Tuberculosis 615
SUNG, H. W., AND TSENG, H. C. Paratyphoid Spondylitis with Paravertebral and Epidural Abscess 615
GUEST, C. MAYNARD, AND JACOBSON, HAROLD G. Pelvic and Extrapelvic Osteopathy in Rheumatoid Spondylitis 615
LACHAPÈLE, A. P., AND LAGARDE, CLAUDE. Spondylolysis 616
GÜNSEL, E. Chondromalacic Spondylosis 616
KIPSHOVEN, H. J. Discontinuities in the Course of the First Ribs 616
SCANDALIS, RICHARD, ET AL. Arthrokatadysis (Otto Pelvis) 616
BÖCK, K. Pelvic Horns 616
GIESEKING, H. Fissure Formation in the Navicular Bone as Post-Traumatic Pseudarthrosis 617
HALE, DEFOREST E. Synovioma 617
SHAFER, SID J., AND LARMON, WILLIAM A. Pigmented Villonodular Synovitis 617

Gynecology and Obstetrics

POLLOCK, MARY, AND PREISKEL, ELLA. Hysterosalpingography with a Water-Soluble Medium in the Investigation of Infertility ... 618
ERBSLÖH, J. Roentgenologic Demonstration of the Female Genital Apparatus with Jodöl and Jodsol 618
KALTREIDER, D. FRANK. The Diagonal Conjugate 619
DENNY, FRANK. "The Flying Foetus" 619

The Genito-Urinary System

BRECKOFF, K. Thorotrast in the Kidney Eleven Years after Pyelography 619
VERMOOTEN, VINCENT. Congenital Cystic Dilatation of the Renal Tubules 619
KIRSCHBAUM, JACK D., AND WILSON, HAL T. Calcinosis of the Kidneys Associated with Parathyroid Tumor 620
VERMOOTEN, VINCENT. Renal Calculi 620
NELLEN, MAURICE. Sjogren's Disease 620
MURPHY, H. B. Observations on Renal Tuberculosis in Newfoundland 621
EGGIMANN, PIERRE. Roentgen Appearance of a Paranephric Abscess Perforating into the Duodenum 621
COPPRIDGE, WILLIAM M., ET AL. Pyelographic Deformity Produced by Hepatic Abscess 621

The Blood Vessels

ISRAELS, M. G. Aneurysm of the Pulmonary Artery 621
McCLEERY, Robert S., ET AL. Subclavius and Anterior Scalene Muscle Compression as a Cause of Intermittent Obstruction of the Subclavian Vein 621
LAWES, C. H. WICKHAM. Some Points in the Management of Varicose Veins 622

Technic; Contrast Media

BUETTI, C. Demonstration of the Atlanto-Epistropheal Joints and Transverse Processes of Atlas and Second Cervical Vertebra 622
ROSSI, LUCIO. Pneumoretroperitoneum 622
ENGSTRÖM, A., AND WEGSTEDT, L. Equipment for Microradiography with Soft Roentgen Rays 622
BROWN, N. M., ET AL. Effects of Ioduron B on the Respiratory Tree of Guinea Pigs 622

Miscellaneous

MORTON, JOHN J. Organ-Displacing Abdominal Tumors 623

RADIOTHERAPY

WINDEYER, B. W. Supervoltage Radiotherapy .. 623
DAHL, ODD. Supervoltage Technique and Engineering 623

MATTICK, WALTER L., AND MATTICK, JOHN W. Management of Cancer of Middle Ear and Mastoid 623
MATTICK, WALTER L., AND MEEHAN, DONALD J. Carcinoma of the Gum 624
GYNNING, INGE. Roentgen Rotation Therapy in Cancer of the Hypopharynx 624
MARTIN, HAYES, ET AL. Neck Dissection 625
GYNNING, INGE. Roentgen Rotation Therapy in Cancer of the Esophagus 625
MÜLLER, J. H., AND ROSSIER, P. H. New Method for the Treatment of Cancer of the Lungs by Means of Artificial Radioactivity (Zn^{63} and Au^{198}) 626
TWOMBLY, GRAY H., AND DI PALMA, SALVATORE. Growth and Spread of Cancer of the Cervix Uteri 626
MEIGS, JOE V. Results of Surgical Treatment of Cancer of the Cervix Uteri 627
NOLAN, JAMES F., AND DU SAULT, LUCILLE. Radiation Treatment of Cancer of the Cervix Uteri 627
SCHMITZ, HERBERT E. End Results of Radiation Treatment of Cancer of the Cervix Uteri 627
BRUNSCHWIG, ALEXANDER. Possibilities of Radical Surgery in Cancer of the Cervix Uteri Recurrent After Radiation Therapy 628
MORTON, JOSEPH L., ET AL. Individualized Interstitial Irradiation of Cancer of the Uterine Cervix Using Cobalt 60 in Needles, Inserted through a Lucite Template 628
KOTTMEIER, H.-L. Dosage Distribution in Pelvis in Radium Treatment of Carcinoma of Uterine Cervix According to the Stockholm Method 629
KISTNER, ROBERT W., AND HERTIG, ARTHUR T. Correlation of Histologic Grade, Clinical Stage, and Radiation Response in Carcinoma of the Uterine Cervix 629
TOD, MARGARET C. Place of X-ray Therapy in the Treatment of Malignant Ovarian Tumours 629
BOGIN, MAXWELL, AND THURMOND, JAMES. Hemangioma with Purpura, Thrombocytopenia and Erythrocytopenia 630
LINDQVIST, ING. Vertebral Hemangioma with Compression of the Spinal Cord 630
CHU, C. S., ET AL. Rhinoscleroma 630
DOIG, R. K., ET AL. Serial Gastric Biopsy Studies on a Case of Duodenal Ulcer Treated by Deep X-ray Therapy 630

RADIOISOTOPES

CATON, WILLIAM L., ET AL. Circulating Red Cell Volume and Body Hematocrit in Normal Pregnancy and the Puerperium by Direct Measurement, Using Radioactive Red Cells 631
ALLEN, HERBERT C., JR., ET AL. Scintillation Counter in Clinical Studies of Human Thyroid Physiology Using I^{131} 631
SLOVITER, HENRY A. Effect of Complete Ablation of Thyroid Tissue by Radioactive Iodine on the Survival of Tumor-bearing Mice 631
LEWISON, EDWARD, F., ET AL. Tracer Studies of Radioactive Sodium Estrone Sulfate (S^{35}) in Cases of Advanced Breast Cancer 631
DZIEWIATKOWSKI, DOMINIC. Radioautographic Visualization of Sulfur-35 Disposition in the Articular Cartilage and Bone of Suckling Rats Following Injection of Labeled Sodium Sulfate 632
MADANSKY, L., AND RASETTI, F. Continuous γ-Radiation of β Emitters 632

RADIATION EFFECTS

BOSWORTH, EDWARD L. Generalized Herpes Zoster 632
ANDERSON, NELSON P., AND ANDERSON, HAROLD E. Development of Basal Cell Epithelioma as a Consequence of Radiodermatitis 632
VAN ALLEN, WILLARD W. Secondary Radiation Limits in Photofluorography 633
BUETTNER, KONRAD. Radiation Effects on Man in Space 633
CONARD, ROBERT A. Effect of X-Irradiation on Intestinal Motility of the Rat 633
COGAN, DAVID G., AND DONALDSON, DAVID D. Experimental Radiation Cataracts 634
TOOSY, M. H. Histological and Chemical Alterations Produced in Mouse Epidermis by Soft X-Radiation 634
VAN DYKE, DONALD C., AND HUFF, REX L. Life Span of White Blood Cells as Measured in Irradiated Parabiotic Rats 635
KREYBERG, LEIV, AND DEVIK, FINN. Skin Reaction to the Subcutaneous Application of Metallic Polonium in Mice 635
SMITH, WILLIE W., AND SMITH, FALCONER. Effect of Thyroid Hormone on Radiation Lethality 635
SMITH, WILLIE W., AND SMITH, FALCONER. Effects of Thyroid and Radiation on Sensitivity to Hypoxia, Basal Rate of O_2 Consumption and Tolerance to Exercise 636
SMITH, FALCONER, AND SMITH, WILLIE W. Exercise Effects on Tolerance to Radiation 636
SOMMERS, SHELDON C., ET AL. Lymphoid Lesions in Poliomyelitis 636
LOEWENTHAL, KURT. Effect of Roentgen Rays on Microsporum Canis 636

THE HEAD AND NECK

Cerebrovascular Accidents: Surgical Management with Particular Reference to Massive Intracranial Hemorrhage. E. S. Gurdjian and J. E. Webster. Arch. Surg. **62**: 724–734, May 1951.

Of a group of 50 patients with cerebrovascular disease and sudden onset of hemiplegia or hemiparesis, 11 who were treated by surgery are considered in this paper.

When the history, neurologic examination, and lumbar puncture suggest the presence of a massive hematoma and the disability remains constant for twenty-four hours under conservative management, the authors advocate cerebral angiography to identify the type and location of the lesion.

In 10 of the 11 cases reported here angiographic studies of the affected carotid circulation were done. The angiogram lateralized the lesion in 7 cases. In 2 instances an angiomatous lesion was located. In 1 case in which the angiogram was normal, the air encephalogram showed a shifting of the left lateral ventricle to the right, with a slight depression of the posterior portion of the ventricle. From their observations the authors conclude that supratentorial lesions in the more forward areas of the brain are well lateralized by angiography, but supratentorial lesions in the posterior third are more accurately lateralized by air studies.

If a massive intracerebral hemorrhage is identified, treatment consists of evacuation of the clot, by trephine aspiration if possible. The extent of the clot may be determined by radiographs obtained after injection of diodrast into the cavity at the time of aspiration. Craniotomy and evacuation are necessary when trephine aspiration is unsuccessful or for the removal of angiomas.

Six roentgenograms; 1 table.

RICHARD A. ELMER, M.D.
Emory University

Widening of the Septum Pellucidum. W. Zaunbauer. Fortschr. a. d. Geb. d. Röntgenstrahlen **74**: 549–555, May 1951. (In German)

According to the author, the height of the septum pellucidum normally ranges between 9 and 15 mm., and the width between 2 and 3 mm. Any deviation from these norms are considered pathologic. Changes of the septum pellucidum which are accessible to x-ray diagnosis are caused (1) by cysts, (2) by agenesis of the corpus callosum, (3) by tumors, and (4) by inflammatory affections.

Cysts of the septum pellucidum may be closed (rare) or communicating. They may communicate with the lateral ventricles or the third ventricle (primary cysts) or may be associated with an internal hydrocephalus as a result of rupture of the wall into the cavum septi (secondary or acquired cyst). A third possibility is communication of the cavum with the subarachnoid spaces (Belloni).

Clinically agenesis of the corpus callosum produces no characteristic symptoms, although extensive hydrocephalus may ensue.

Two kinds of tumors produce alterations in the appearance of the septum pellucidum: tumors of the septum pellucidum proper and tumors of the corpus callosum. Tumors of the septum pellucidum are rare; Lowman and collaborators (Am. J. Roentgenol. **59**: 177, 1948. Abst. in Radiology **51**: 882, 1948) could find only 8 in the medical literature (5 gliomas, 1 glioblastoma, and 2 fibrillary astrocytomas), to which they added 3 cases of their own (2 astrocytomas and one not histologically classified). Zaunbauer has seen only two cases of tumors of the septum pellucidum in over 10,000 pneumographies (1 astrocytoma and 1 oligodendroglioma). Tumors of the corpus callosum are equally rare. The author describes such a tumor of calcifying type, presumably an oligodendroglioma.

A case of widening of the septum pellucidum due to inflammation is discussed in detail. The inflammation was the result of a war injury by bomb fragments. Following brain prolapse and operation, meningitis occurred. By encephalography, pathologic changes in the septum pellucidum were demonstrated. After disappearance of the symptoms (fever and headaches), in the course of about three weeks, the enlargement of the septum pellucidum receded.

Eight roentgenograms.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Colloid Cyst of the Third Ventricle. Hugh Cairns and William H. Mosberg, Jr. Surg., Gynec. & Obst. **92**: 545–570, May 1951.

Of all intracranial tumors, colloid cyst of the third ventricle is the most constant in its situation and extent. It occurs invariably at the foramina of Monro and is attached to the choroid plexuses of the lateral ventricles where these structures become continuous with the small veins of Galen. The danger from such a cyst lies in the possibility of hydrocephalus from obstruction of the foramina of Monro. Nineteen cases are reported here.

There are so few features which distinguish a colloid cyst of the third ventricle from other lesions producing an increase of intracranial pressure that a positive diagnosis would be virtually impossible without ventriculography, but the neurologist should be familiar with the clinical manifestations so that he may suspect the condition before resorting to special diagnostic procedures. Most of the symptoms are due to hydrocephalus, but there is great variation in the clinical picture, depending upon the acuteness of the obstruction of the foramina of Monro. The picture varies from acute and rapidly fatal headache to chronic organic dementia without headache. Freedom from symptoms from periods of two weeks up to ten years occurred in 9 of the authors' cases.

Ventriculograms of the cyst in 1 case showed that when the cyst blocks the foramina of Monro the anterior part of the third ventricle is displaced downward. In addition the cyst may impinge upon the upper part of the hypothalamus.

During the acute hydrocephalic attack sugar may be found in the urine. It is thought that the renal threshold for sugar is affected.

Transventricular removal of the cyst is the treatment of choice.

Of interest to radiologists is the authors' statement that in any given case of raised intracranial pressure there is need to decide whether to employ arteriography or ventriculography. In Britain the present tendency

is to use arteriography in suspected tumors of the cerebral hemisphere, and ventriculography in suspected tumors of the third ventricle and posterior fossa. Some colloid cysts masquerade clinically as hemisphere tumors, and in these arteriography fails to reveal the site and nature of the lesion, merely indicating the presence of a hydrocephalus.

In ventriculography for suspected colloid cysts it is essential that the replacement of cerebrospinal fluid by air should be as complete as possible; otherwise, all that the ventriculogram will show is obstruction at the level of the foramina of Monro, and the clinician may be left in doubt as to whether he is dealing with massive irremovable tumor of the third ventricle, which should be treated by ventriculocysternostomy, or colloid cyst, which should be removed. In any case, the final decision on this question should be made on clinical judgment as well as on x-ray appearances.

There is abundant evidence that after ventriculography patients with colloid cysts may quickly collapse and die unless the air injection is promptly followed by operative removal of the cyst or decompression.

Fifteen illustrations; 2 tables.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Localisation of Cerebral Tumours with Radioactive Derivatives of Fluorescein. Physical Limitations. E. H. Belcher and H. D. Evans. Brit. J. Radiol. **24**: 272–279, May 1951.

Experimental localization of tubes of radioactive material in a gelatine-filled skull was made with the use of a scintillation counter. The apparatus and calibration are described. It was found that lesions which could concentrate the radioactive dye to ten times the concentration in normal brain tissue could be detected within certain limiting sizes and depths. At 5 cm. depth the limiting volume is 14 c.c. At 8 cm. it is 36 c.c.

Improvement in counter design might contribute to better results.

Six illustrations; 3 tables.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Some Preliminary Clinical Observations on the Use of Radioactive Isotopes for the Localisation of Brain Tumours. Jan G. deWinter. Brit. J. Radiol. **24**: 280–284, May 1951.

Thirty-four cases of suspected brain tumors were tested by the method described in the article by Belcher and Evans (see preceding abstract). Approximately 1 mc. of I^{131} was injected intravenously in the form of diiodofluorescein in all but 2 cases, in which dibromofluorescein was used. Counting in the first few cases was begun immediately after injection of the dye, but in the later cases an interval of two hours was allowed before the first counts were made.

Of the 34 suspected tumors, 20 were subsequently verified. In only one of the 20 was evidence of a brain tumor found by counting differential radioactivity. The author concludes that the method may be useful in physiological investigations but is of little value in tumor localization.

Twelve illustrations, including 4 roentgenograms; 1 table.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Radiographic Findings in 14 Cases of Sturge-Weber Syndrome. Giovanni Di Chiro and Erik Lindgren. Acta radiol. **35**: 387–399, May–June 1951.

Fourteen cases of Sturge-Weber syndrome (10 proved pathologically) from the Serafimer Hospital, Stockholm, were studied in an effort to determine what radiological assistance can be offered in diagnosing this condition beyond the demonstration of typical double-contour linear calcifications. Preliminary plain films were obtained in all cases; encephalography was done in 11, internal carotid angiography in 7, and external carotid angiography in 1.

In the conventional roentgenograms skull asymmetry was found in 10 cases. The underdeveloped part of the skull is always on the side of the lesion and overlies the involved portion of the brain. The asymmetry is usually best shown in a half-axial view since involvement of the occipital area is frequent.

Enlarged vascular channels were found in 6 cases and may be especially significant in localizing the lesions in the absence of calcification. These channels are always diploic veins and not arterial grooves.

Typical calcifications were seen in 9 cases, and atypical calcification in 3. Two cases showed no calcium despite the fact that calcification in the cortex and abnormal vessels is always demonstrable histologically in this disease. Double-contour calcification, though typical, is not pathognomonic of the Sturge-Weber syndrome, since it may be seen in gliomas as well.

Of the 11 encephalograms, 4 were normal, while 5 showed ipsilateral enlargement of the lateral ventricle and 6 revealed a more striking enlargement of the subarachnoid space. This latter change may be present without ventricular enlargement.

The use of carotid angiography has not been diagnostic of this syndrome in the experience of the authors. They feel that its value lies rather in excluding other conditions, such as arteriovenous aneurysms or complicating intracerebral hemorrhage. They concede, however, that roentgenograms made during the capillary phase might offer some help. This phase was not studied by them.

Fourteen roentgenograms. D. E. VIVIAN, M.D.
Indiana University

Ocular Complications Encountered in Intracranial Arteriography. Harold F. Falls, Robert C. Bassett, and Austin E. Lamberts. Arch. Ophth. **45**: 623–626, June 1951.

Eighty consecutive cases in which intracranial angiography was done, at the University Hospital, Ann Arbor, Mich., were reviewed for evidence of ocular complications. *Conjunctival petechiae*, especially in the fornices, occurred with great constancy (81.3 per cent) following this procedure. They could be visualized almost immediately on completion of the perfusion of the contrast medium in some patients; in others the hemorrhages were not apparent until thirty to ninety minutes after operation. While adequate proof is lacking, some correlation between the frequency and severity of the petechiae and the amount of contrast substance injected is suggested. Retinal hemorrhages were found in 20 patients. The majority of these hemorrhages were round and granular; in a few instances they were preretinal. While an occasional hemorrhage was seen in the retinal periphery, the larger number were confined to the posterior pole. Many of the hemorrhages had white centers, and in

numerous instances cotton-wool exudates were also present.

Severe *optic neuritis* was encountered in 1 patient, with eventual complete loss of vision. Temporary visual loss (ten to thirty minutes), thought to be vasospastic in nature, was observed twice, with subsequent return to normal. The homolateral pupil was temporarily dilated in 5 instances, with return to normal within three to twenty-four hours. Pain in and about the eye was complained of by 2 patients in whom iodopyracet was used as the contrast medium. One death, secondary to thrombosis of the internal carotid artery, followed intracranial angiography.

In 11 patients, or 13.8 per cent, no ocular complications were observed.

It is impossible to state the cause of the ocular complications, but they undoubtedly result from vascular change secondary to allergic, toxic, or physical phenomena.

The records of 457 patients undergoing intracranial arteriography (1941–50) were reviewed for the occurrence of sequelae of a serious neurological nature. Four patients became seriously comatose, 6 had hemiplegia or hemiparesis, and 6 experienced convulsions. On introduction of the needle, spasm of the carotid artery was encountered twice.

Acute Parotitis. Jack R. Gustafson. Surgery **29:** 786–801, May 1951.

In this review of acute postoperative parotitis the author devotes some space to treatment by radium and roentgen rays. Rankin and Palmer (Ann. Surg. **92:** 1007, 1930. Abst. in Radiology **16:** 806, 1931) first reported on the use of radium, and a series of 111 cases successfully treated by this means was recorded by Fricke and Madding of the Mayo Clinic (Radiology **38:** 294, 1942). Roentgen irradiation has since come into more general use, and various reports concerning the excellent results thus obtained are cited (see, for example, Pendergrass and Hodes: Radiology **38:** 307, 1942). The usual cure rate following roentgen therapy without drainage ranges from 65 to 80 per cent.

The author's own series of cases numbered 80, of which 78 received x-ray therapy either alone or in combination with the sulfonamides or penicillin. Ten patients died before completion of treatment. In 52 of the remaining 68, prompt resolution was obtained without abscess formation; 16 required incision and drainage. It was found that treatment was more effective when given early, and the author has come to regard acute parotitis as a radiotherapeutic emergency.

The role of chemotherapy as an adjuvant to irradiation is not definitely determined.

Five illustrations; 8 tables.

Tumors of the Jaws. John C. Glenn, Jr., Allen Taylor, and Robert J. Reeves. South. M. J. **44:** 481–487, June 1951.

Tumors of the jaws, as a group, from the standpoint of accurate diagnosis and adequate treatment are frequently neglected. In their earliest stages, these tumors are more commonly seen by dentists. If properly diagnosed and treated at this time they can be eradicated with good cosmetic and functional results.

The clinical and x-ray findings of 163 primary jaw tumors observed at Duke Hospital (Durham, N. C.) are reviewed. These occurred in 161 patients seen from July 1, 1930, to July 1, 1950. The tumors are classified according to histologic origin: ectoderm, ectoderm and mesoderm together, and mesoderm. The authors give a list of the various tumors found in their services, with a breakdown as to location of the tumor, number of cases of each type, age, duration of symptoms, clinical features, and radiographic findings.

Tumors of the jaw consist of the same tissues as tumors in other areas of the body. They are confined to a small area and thus, even though benign, may readily produce pressure on adjacent vital structures. If the tumor has persisted for a long time, with few, symptoms except deformity, it is most likely benign. Pain and rapid growth indicate malignancy.

The treatment of choice for all primary tumors of the jaws, except the sarcomas arising from the bone, is complete excision. Radiation therapy is of value only in the sarcomas (except fibrosarcoma).

Five roentgenograms; 2 drawings; 2 tables.

J. M. KOHL, M.D.
Jefferson Medical College

Tumours of the Jaw. William Campbell. J. Faculty Radiologists **2:** 272–284, April 1951.

The necessity of correlation of both clinical and radiological examination is stressed by the author in his discussion of "abnormal productions derived from the dental formative organs." Congenital malformations, adamantinomas, dental cyst, dentigerous cyst, fibrous dysplasia, benign giant-cell tumor, central fibroma, central myxoma, simple cyst, and sarcoma of the mandible are discussed from the point of view of embryology and pathogenesis. The simple fact that the mandible is developed in its posterior portions in membrane and in its anterior part from cartilage is stressed as an aid in the consideration of giant-cell tumor and generally in the differentiation of other cystic tumors.

The locally malignant adamantinoma is a very important tumor of the mandible and can occur in a wide age group. One of the author's patients was a boy of ten, though the average age is thirty to thirty-five years.

The permanent molar teeth, which have no deciduous precursors, are formed from a backward extension of the dental lamina. It is postulated that this backward extension of the dental lamina may proliferate wrongly and cells which should produce the enamel part of the tooth produce instead an adamantinoma. Essentially four radiologic types of this tumor are described by the author as follows: (1) the "characteristic" radiologic appearance of multicystic destruction in the anterior aspect of the ascending ramus with incomplete loculation and coarse bony trabeculations in the cavity; (2) a large solitary cyst-like destruction with clean-cut edges, bone expansion, and with a slight notching effect in some areas of the periphery produced by a smooth tumor with small solid nodules; (3) apparently multicystic areas of destruction, combined with displacement of otherwise normally erupted teeth or with the clean-cut shearing of the root of a tooth, indicating that the tumor is at least in part solid; (4) a fairly coarse honeycomb effect with well defined corticated bone posteriorly, and sharp demarcation present either anteriorly or posteriorly, but usually not both.

A few differential features of the other lesions under discussion are mentioned.

Eleven roentgenograms; 9 photographs; 3 drawings.

RICHARD A. ELMER, M.D.
Emory University

THE CHEST

Standardized Oblique Roentgenography of the Chest. Sherman W. Atwell. Dis. of Chest **19**: 585–588, May 1951.

The author stresses the desirability of a standard oblique position for chest examination which can be duplicated on repeated examinations. He finds that it is rarely the postero-anterior or lateral but usually an oblique projection which shows a lesion to best advantage. Such a projection will also aid in the examination of obscure areas of the hilus, apex, and left base. With this in mind, a homemade cassette-holding device has been constructed, by which oblique projections at predetermined fixed angles can be obtained. Best results are achieved with an angulation between 20 and 30 degrees depending upon the depth of the chest.

Nine roentgenograms; 2 photographs.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Clinical and Experimental Studies in the Use of a Water-Soluble Agent for Bronchography. Mordant E. Peck, A. J. Neerken, and Emanuel Salzman. Surg., Gynec. & Obst. **92**: 685–692, June 1951.

Lipiodol has traditionally been used for bronchography. Some of it remains in the alveoli, and its continued presence may lead to misinterpretation of subsequent roentgenograms. There are also some inherent dangers associated with reactions to the injected material. These are of three types: (1) a rather mild reaction, manifested by coryza, lacrimation, and swelling of the salivary glands, and sometimes skin eruption, attributed to the breakdown of the swallowed oil in the intestinal tract, with subsequent absorption of the iodine; (2) purpura, a hemorrhagic rash, and generalized edema, which may result in a respiratory death from pulmonary edema several days after onset; (3) an anaphylactic reaction, usually fatal.

An ideal agent would be viscous, capable of mixing freely with body fluids, stable, readily absorbed from the organs visualized, non-irritating, and incapable of producing significant abnormalities in the tissues with which it comes in contact. The authors have prepared a substance which they think approaches this ideal. It is a 1.75 per cent solution of methylcellulose, in 50 per cent diodrast. The material was first tried on guinea-pigs, with the occasional production of small focal areas of atelectasis. It was then used in a series of dogs. A high incidence of bronchopneumonia was observed in these animals, but in a second series, anesthetized with sodium pentothal instead of nembutal, this complication was less frequent, though 2 dogs out of 10 still showed gross and microscopic evidence of bronchopneumonia. Frank bronchopneumonia, however, or evidence of peribronchial infiltration also developed in dogs receiving iodochloral, a preparation similar to lipiodol, though this preparation had been used routinely in patients. On this basis, the authors concluded that it was safe to proceed with the clinical investigation of the methylcel-diodrast mixture. They tried it on an unstated number of patients, and report no untoward effects to date. Three cases are reported to illustrate the purported usefulness of the medium.

Seventeen roentgenograms.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Total Left Pulmonary Atelectasis After Bronchography. K. Reinhardt. J. de radiol. et d'électrol. **32**: 470–473, 1951. (In French)

This is an interesting case report of a 42-year-old patient who was studied for a somewhat obscure type of pulmonary infiltration in the left upper lung field. Bronchography was performed, with 2 per cent novocaine as an anesthetic and lipiodol as the opaque medium. The bronchial tree showed many irregularities and small cavities were visualized. After bronchography, treatment was begun with endotracheal instillations of penicillin, supplemented by parenteral injections. The patient was apparently doing fairly satisfactorily when another film was taken after about three weeks, which showed complete atelectasis of the left lung. There was a somewhat clearer area of relative radiolucence near the left hilus, presenting a semilunar shape. Since it was believed that this atelectasis was not on the basis of bronchial obstruction, a roentgenogram was made two weeks later for control study. This revealed an enlargement of the perihilar lucent area. A second bronchogram was then obtained, which showed no definite evidence of bronchial obstruction. In fact, the bronchial lumina were enlarged. The author discusses various theories regarding atelectasis and concludes that in this case it might be the result of a neuromuscular reflex.

Four roentgenograms. CHARLES M. NICE, M.D.
University of Minnesota

Classification of Pulmonary Tuberculosis with Five Digit Code. B. Papanicolaou. Dis. of Chest **19**: 577–584, May 1951.

The author proposes a universal classification for pulmonary tuberculosis with five major digits and ten subdivisions for each digit. This is an elaboration and extension of the descriptive classification introduced by Hilleboe and Holm (Bull. World Health Organization, June 1948), which provided a four-digit code giving information as to relative infectivity, cavitation, lesions, and principal symptoms. The author's code is summarized in a five-digit number, with the digits positioned so that the first always relates to the first category (T) tubercle bacilli; the second to the type and form (F) of the disease, as determined by x-ray examination; the third to the localization of lesions (L); the fourth to cavities and pleural exudate (C); the fifth to the clinical status in connection with the symptomatology (S). Ten selected findings for each of the five categories are arranged in a pattern. Each finding is assigned a digit from 0 to 9 and an increase in the order of the digit indicates an increase in the seriousness of the finding.

The classification is as follows:

I.	Laboratory (Tubercle Bacilli: Present +, Absent 0)	
	0. No examination	–
	1. Gastric (or bronchial) lavage culture	0
	2. Sputum culture	0
	3. Sputum concentrate (no culture made)	0
	4. Sputum. Direct smear (no other examination made)	0
	5. No expectoration. Gastric (or bronchial) lavage not done	–
	6. Gastric (or bronchial) lavage culture	+
	7. Sputum culture	+
	8. Sputum concentrate	+
	9. Sputum direct smear	+

II. Chest X-Ray Film Inspection (Type and Form of the Disease)
- 0. No alterations in the lung fields.
- 1. Primary tuberculosis, perihilar infiltrate.
- 2. Primary tuberculosis, fissural infiltrate.
- 3. Reinfection tuberculosis, early infiltrate.
- 4. Reinfection tuberculosis, nodular dissemination.
- 5. Reinfection tuberculosis, generalized nodular (miliary).
- 6. Reinfection tuberculosis, mixed prevailing nodular.
- 7. Reinfection tuberculosis, mixed prevailing patch.
- 8. Reinfection tuberculosis, homogeneous patch.
- 9. Reinfection tuberculosis, non-homogeneous patch.

III. Chest X-Ray Film Inspection (Localization of Lesions)
- 0. Apex of one lung.
- 1. Upper or lower lung of one side.
- 2. Apices of both lungs.
- 3. Apex with upper or lower lung of the other side
- 4. One lung.
- 5. Both upper lungs.
- 6. Upper lung with lower lung of the other side.
- 7. Both lower lungs.
- 8. Apex or upper or lower lung with the other lung.
- 9. Both lungs.

IV. Chest X-ray Film Inspection (Cavities and Pleural Effusions)
- 0. No cavity.
- 1. Effusion in pleural space.
- 2. Suspected cavity on one side.
- 3. Effusion in pleural space with suspected cavity on one side.
- 4. Suspected cavities on both sides.
- 5. Effusion in pleural space with suspected cavities on both sides.
- 6. Cavity on one side.
- 7. Effusion in pleural space and cavity on one side.
- 8. Cavities on both sides.
- 9. Effusion in pleural space with cavities on both sides.

V. Clinical Status: Symptomatology
- 0. Clinically not significant (apparently healed more than two years ago).
- 1. Clinically not significant (apparently healed less than two years ago).
- 2. Probably clinically significant. Observation case without symptoms.
- 3. Probably clinically significant. Observation case with slight symptoms.
- 4. Clinically significant. Treatment case without symptoms.
- 5. Clinically significant. Treatment case with slight symptoms.
- 6. Clinically significant. Treatment case with moderate symptoms.
- 7. Clinically significant. Treatment case with severe symptoms.
- 8. Clinically significant. Treatment case with moderate symptoms and extrapulmonary tuberculosis.
- 9. Clinically significant. Treatment case with severe symptoms and extrapulmonary tuberculosis.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Tuberculous Cavities of the Lower Lobe. Results of Treatment in 103 Patients. John S. Chambers, Jr. Am. Rev. Tuberc. **63:** 625–643, June 1951.

This presentation deals with two groups of patients: (A) those with a lower lobe cavity with tuberculosis confined to that lobe; (B) lesions in other lobes, but with the lower lobe cavity constituting the principal problem in therapy.

There is no satisfactory explanation for the types of localization of tuberculosis in the lungs. Roentgen evidence of lower lobe cavitation was found in 17.9 per cent of a group of 2,162 patients with moderately or far advanced reinfection type of pulmonary tuberculosis admitted to the Michigan State Sanatorium in a ten-year period (1937–47). Since the designations "moderately" or "far" advanced do not necessarily mean cavitary lesions in all cases, the incidence of lower lobe cavity in cavitary tuberculosis is undoubtedly higher, probably ranging from 20 to 25 per cent.

Of 57 patients with disease limited to the lower lobe, 24 were males and 33 females, and this tends to confirm earlier reports that females are more prone to lower lobe disease than males. No figures are given for group B. The author emphasizes the value of stereoscopic postero-anterior roentgenograms as well as lateral and oblique views in the diagnosis of lower lobe cavitation.

Prognosis is no different than in the more frequent involvement of the upper portion of the upper lobe. The extent of the disease was of significance in prognosis in the present series, 84 per cent of the cases of solitary disease becoming inactive as against 54 per cent in the group with more widespread disease. The presence of a fluid level within a cavity (apparently indicating bronchial disease in many instances) was also of prognostic significance, with 14 per cent fewer cases becoming inactive than among patients with no fluid level. Evidence of bronchial disease was found in 74 per cent of patients in group A. A similarly high incidence has been reported in other series of lower lobe cavitary disease. Of the cases of disease limited to the lower lobe, 74 per cent with subapical and basal cavities eventually became inactive, as compared with 90 per cent of those with apical cavities.

The results of treatment of lower lobe cavitary tuberculosis in this series indicate that pneumothorax, phrenic nerve interruption, and a combination of the two are all effective, with no statistically important difference in results. The disease became inactive in 73 cases; 12 cases remained active, and 18 patients died. In group A the disease was fatal in 5 cases and remained active in 4 patients. The average follow-up period in the series was four and a half years.

The author feels that pneumoperitoneum with phrenic paralysis is now the treatment of choice, since there is less morbidity than with pneumothorax. The value of streptomycin was not analyzed, since only a few patients received it. The number of patients who had thoracoplasty, cavernostomy, or resection was too small for evaluation.

Seven tables.

JOHN H. JUHL, M.D.
University of Wisconsin

Bilateral Tuberculous Bronchostenosis in a Patient with Normal Chest Roentgenographic Findings. John S. Packard. Am. Rev. Tuberc. **63:** 706–709, June 1951.

A case is reported in which the diagnosis of bilateral tuberculous bronchitis with bronchostenosis was made by bronchoscopy and the patient was followed to healing of the visible lesions and to a tubercle bacillus-free sputum in a period of a year. Streptomycin and PAS were used in treating the disease. Chest films were normal; fluoroscopy is not mentioned in the report.

Bilateral bronchostenosis is rare. The author could find no previous similar case in the medical literature, but has since seen a patient with bronchostenosis in the left main bronchus, following the removal of the right lung some years earlier because of complete stenosis of the main bronchus complicating total tuberculosis of that lung.

Early use of antimicrobial agents may prevent severe stenosis, and the possibility of plastic repair of stenosis in patients without parenchymal disease may make the prognosis somewhat better than it has been.

One roentgenogram; one drawing.

JOHN H. JUHL, M.D.
University of Wisconsin

Angiocardiographic Findings in Pulmonary Tuberculosis. Israel Steinberg, Herbert I. McCoy, and Charles T. Dotter. Dis. of Chest **19:** 510–520, May 1951.

The authors summarize their findings in 91 cases of pulmonary, hilar and mediastinal tuberculosis seen over a fourteen-year period. The cases were classified as fibrocavernous, 49; caseocavernous, 9; caseous, 8; fibrocalcific, 7; fibroid, 6; hilar and mediastinal lymph node tuberculosis, 6; hematogenous (nonmiliary), 3; miliary, 1; silicotuberculosis, 1. Of these, 19 were regarded as minimal, 46 as moderately advanced, and 26 as far advanced.

Pulmonary angiography revealed diminished vascularity of varying degree in the diseased areas. The changes observed were variations in caliber, degree and rate of filling, position and configuration of the pulmonary arterial tree. The degree of vascularity depended upon the amount of lung tissue involved. Displacement of vessels secondary to fibrosis and retraction was frequently encountered. In tuberculous fibrothorax, angiocardiography delineated the cardiac chambers and great vessels, often revealing marked distortion and displacement of these structures. By contrast visualization, it was found possible to differentiate hilar and mediastinal masses from aneurysm. In 2 instances, tuberculous hilar and mediastinal nodes produced obstruction of major branches of the pulmonary artery. Finally cardiac chamber demonstration was utilized to establish the presence of pericardial effusion.

Twelve roentgenograms.

HENRY K. TAYLOR, M.D.
New York, N. Y.

"Positive Sputum" Without Pulmonary Tuberculosis. Pitfalls of Positive Sputum Interpretation, with Eight Clinico-roentgen Observations. Louis Schneider and Daniel Widelock. Am. Practitioner **2:** 428–433, May 1951.

The authors note that the demonstration of tubercle bacilli in the sputum is the most conclusive evidence of pulmonary tuberculosis. In order to identify the bacilli positively, culture or animal inoculation is necessary. Simply finding acid-fast organisms in the sputum does not distinguish between tuberculosis and conditions due to other types of acid-fast organisms. The authors list 17 acid-fast organisms that may be mistaken for *M. tuberculosis*. Most are saprophytes. The bacteriologist can usually differentiate these from the tubercle bacillus by their different rates of growth and colony characteristics.

Approximately 1 per cent of the sputa examined for tubercle bacilli will be positive for acid-fast organisms that are not clinically significant. With rare exceptions, a positive sputum obtained from a patient whose chest film is normal is not due to pulmonary tuberculosis. Nor does a single positive sputum indicate activity in a case of arrested tuberculosis and call for further sanitarium care.

A number of case histories, together with the relevant films, are shown, illustrating how "positive sputum" has led to errors in diagnosis and treatment. These show the need for critical appraisal by the clinician when confronted with the report "sputum positive for acid-fast bacilli on smear." When the report of a positive sputum does not agree with the clinico-roentgen findings in a given case, further laboratory and special roentgen-ray studies are suggested for the proper evaluation of the pulmonary problem that presents itself to the attending physician.

Six roentgenograms.

BERTRAM LEVIN, M.D.
Chicago, Ill.

Significance and Management of Peripheral Pulmonary Masses. Osler A. Abbott, William A. Hopkins, Ted F. Leigh, and William E. Van Fleit. J. M. A. Georgia **40:** 243–249, June 1951.

The experiences of the authors in the diagnosis of 81 proved cases of solitary peripheral lesions of the lung (sometimes called "coin lesions") are well covered by tables and representative roentgenograms. The lesion was due to neoplasm in 39 cases, tuberculosis in 17 cases, granuloma in 9, lung abscess (blocked) in 6, congenital defects in 5, and to other, miscellaneous conditions in 5.

It is interesting to note that while the diagnosis was made by thoracotomy in 54 cases, roentgenography afforded a positive diagnosis in 12, and was of definite assistance in others. Laminagrams were of importance, particularly in one case of bronchogenic carcinoma, where the finger-like projections of the mass were demonstrated. Angiocardiography proved useful in selected cases. In one patient the diagnosis of an arteriovenous fistula was established by this method. Bronchography has not proved of any particular value.

Eleven roentgenograms.

JOSEPH T. DANZER, M.D.
Oil City, Penna.

The Most Detectable Internal Cancer. Richard H. Overholt. South. M. J. **44:** 493–498, June 1951.

Overholt points out that survey chest films offer a practical means for early detection of lung cancer, consuming a minimum of the physician's time as compared to methods of detecting most other forms of cancer. Furthermore, very small and very early cancers of the lung can be discovered in this manner.

It is estimated that from 25 to 35 per cent of "suspect" shadows in survey chest roentgenograms prove to

be cancer. The author feels that in cases with shadows in the roentgenogram which may represent cancer, negative bronchoscopic or cytologic examination should not be taken as good evidence against it. Surgical exploration is advised for diagnostic purposes in such cases. Time-consuming procedures such as cultures for tubercle bacilli and observation of a shadow in roentgenograms over a period of a month or more cause unjustifiable delay in surgery.

Symptomatic lung cancer has a high incidence (89 per cent) of lymphatic metastasis and a resultant low surgical cure rate. Conversely, there is a low incidence (about 25 per cent) of metastasis in asymptomatic lung cancer which is resected promptly, and the author feels that there will probably be a proportionately increased cure rate in such cases when enough time has elapsed for their evaluation.

Because of the ease of finding asymptomatic lung cancer by the survey method and the expected high cure rate in asymptomatic cases, Overholt believes that primary lung cancer should have the highest cure rate of all internal cancers.

Five roentgenograms; 4 photographs.

T. FREDERICK WEILAND, M.D.
Jefferson Medical College

Alveolar Cell Tumour of the Lung. J. G. Stapleton and E. C. Janes. J. Canad. Assoc. Radiologists **2:** 28–32, June 1951.

Alveolar-cell carcinoma of the lung is a rare, slowly growing, but apparently always fatal tumor which seems to arise multicentrically in the alveoli. Most of the cases show well differentiated cells and the lymph nodes may or may not be invaded.

Cough, dyspnea, and copious frothy sputum comprise the clinical symptoms, mild at first, later extremely severe. Hemoptysis is unusual except with complicating pneumonia.

Roentgenologically the usual finding is one (early) or more areas of ill-defined, fairly homogeneous infiltration without atelectasis, hilar node enlargement, or pleural reaction. A few cases have a nodular appearance due to infiltration, and cavitation is occasionally seen. Gradual increase in size of the lesion takes place and new areas arise, until eventually almost all of both lung fields may be radiologically opaque.

The only treatment is surgical, and operation must be done long before a definite diagnosis can be made from the clinical or x-ray findings if it is to be beneficial. This disease is one of the reasons for urging resection of unidentifiable solid lung lesions.

A single case report is given, with 6 roentgenograms showing typical progression over three and a half years.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Silicosis Among Iron Foundry Workers. Saul Solomon. New York State J. Med. **51:** 1045–1048, April 15, 1951.

A survey of 641 employees of an iron foundry in New York revealed 83 cases of silicosis, of which 10 were classified as severe, 28 as moderate, and 45 as mild.

The authors believe that routine surveys for dust diseases should be made annually in foundries, so that silicosis may be discovered before it is far advanced, and that changes in the present compensation laws relating to silicosis should be considered, making partial disability compensable to the point where the disabled employes may seek another occupation without great economic hardship.

There is no clear-cut relationship between x-ray findings and disability. The disability is a functional one depending not merely on fibrotic changes in the lungs, but on emphysema, bronchiectasis, secondary infection, and distortion of the pulmonary vascular bed.

The absence of any diagnosable cases of pulmonary tuberculosis among the 641 employes studied is interesting. It may be related to the drop in the tuberculosis rate in the nation and in this community in particular. This finding lends support to the belief that tuberculosis is related less to a specific occupation than to economic factors, public health measures, and the opportunities for contact.

Four roentgenograms; one table.

DANIEL WILNER, M.D.
Atlantic City, N. J.

Lobar Emphysema Simulating a Giant Emphysematous Bulla. Ph. Daumet and J. Le Melletier. J. franç. méd. et chir. thorac. **5:** 340–342, 1951. (In French)

A 15-year-old girl was examined because her sister had been found to have a tuberculous lesion. A negative tuberculin reaction was obtained, but the chest roentgenogram showed a large radiolucent area in the left upper lung field. A small rim of compressed lung tissue was noted at the edge, thus suggesting the diagnosis of a large emphysematous bulla. Tomograms revealed no hilar mass, although the plain roentgenogram showed what was apparently a small hilar nodal enlargement. On thoracotomy the left upper lobe, excluding the lingular portion, was found to be distended. The pulmonary tissue filled and emptied in such a manner as to suggest a valvular mechanism. It was believed that the small hilar node compressed a portion of the left upper lobe bronchus.

One roentgenogram. CHARLES M. NICE, M.D.
University of Minnesota

Pneumothorax as a Complication of Pneumoperitoneum. Jack Foy Wu and Wilford B. Neptune. Am. Rev. Tuberc. **63:** 710–713, June 1951.

In a woman of 40 years pneumothorax developed five days following initial pneumoperitoneum (Oct. 23, 1950) for treatment of tuberculosis. A refill was given on Oct. 26 and two days later severe dyspnea ensued, following which fluoroscopy revealed pneumothorax on the right with no residual gas in the peritoneal cavity.

All of the previously reported cases of pneumothorax complicating pneumoperitoneum have been right-sided, due probably to the displacement of the liver with exposure of the right diaphragm to unusual pressures. Aspiration to re-expand the lung and decompress the hemithorax is usually indicated.

Three roentgenograms JOHN H. JUHL, M.D.
University of Wisconsin

Nodal Calcification and Serious Hemoptysis. Mathey and Mannes. J. franç. méd. et chir. thorac. **5:** 351–353, 1951. (In French).

A 35-year-old woman complained of fatigue and anterior chest pain of three years duration. At the age of sixteen she had suffered an episode of hemoptysis; then at nineteen, hemoptysis occurred on five or six occasions. At the time of these early episodes the

patient was apparently in good health. The more recent state of fatigue and general debilitation had led another physician to suggest sanatorial care, although tubercle bacilli had never been demonstrated in the sputum.

Roentgenographic studies revealed complete collapse of the right middle lobe with a large calcified node near the middle lobe bronchus. At surgical exploration, the calcified node was found to be invading the right middle lobe bronchus and to be intimately connected to the right pulmonary artery, almost occluding the latter. It was noteworthy that this patient had never suffered an episode of suppuration.

Three roentgenograms. CHARLES M. NICE, M.D.
University of Minnesota

Migratory Pneumonia Without Eosinophilia. David Biber and Arthur Buckler. Dis. of Chest **19**: 593–597, May 1951.

The authors give the case history of a 56-year-old housewife who was acutely ill, showing evidences of a migratory pneumonia without an eosinophilia. They report the case because of the absence of the characteristics of Loeffler's syndrome.

Eight roentgenograms; 1 chart.
HENRY K. TAYLOR, M.D.
New York, N. Y.

Mediastinal Cysts of Embryologic Origin. Howard P. Doub. J. Faculty Radiologists **2**: 302–311, April 1951.

The increase in recent years in number and quality of roentgen examinations of the chest has been responsible for the discovery of an increasing number of cystic lesions in the living patient, while advances in surgical technic have made elective operations in this area relatively safe.

Dermoid cysts and teratomas usually appear as sharply defined round or oval masses originating in the anterior mediastinum and extending over one side of the chest. Teratomas may be irregular in outline. Dense shadows due to teeth, bone, or calcification may be seen, and rarely there occurs a layering of liquid fat floating on aqueous fluid.

The bronchogenic cyst, when uncomplicated by bronchial communication, infection, or bronchial compression, usually appears as a smooth round or oval shadow in the posterior mediastinum near the tracheal bifurcation, though it may be found anywhere in the mediastinum. Frequently there is attachment to the trachea. Calcification is uncommon.

Pericardial cysts are in most instances located in the anterior mediastinum and may change contour with phases of respiration, appearing long and narrow with inspiration, and shorter and wider on expiration. This may prove to be an important sign.

Enterogenous cysts may be present anywhere along the mediastinum in direct contact with the esophagus, probably occurring most often in the middle third.

These are some of the characteristics that aid in differentiating mediastinal cystic lesions one from another, but a specific diagnosis is not always possible. Most chest tumors and cysts should be removed surgically and the author stresses that radiation therapy is not justified when the diagnosis is equivocal.

Fifteen radiographs. RICHARD A. ELMER, M.D.
Emory University

Roentgenologic Diagnosis of Congenital Cardiovascular Malformations. David M. Gould. Am. J. M. Sc. **221**: 581–594, May 1951.

A good review of the literature on the roentgenologic diagnosis of congenital cardiovascular malformations, with an excellent bibliography. Most of the articles mentioned have appeared in the original or in abstract form in RADIOLOGY.

Effect of Angiocardiography on the Heart as Measured by Electrocardiographic Alterations. Willard J. Zinn, David C. Levinson, Varner Johns, and George C. Griffith. Circulation **3**: 658–662, May 1951.

Continuous direct reading electrocardiography showed that bursts of abnormal rhythms as well as S-T segment and T wave changes occur after the injection of neo-iopax (75 per cent) for angiocardiography. The S-T changes and the abnormal rhythms are probably caused by increased permeability brought about by direct toxic action of the medium on the small vessels. The T wave changes are thought to be due to the bolus of non-oxygen-carrying medium passing through the coronary circulation, producing transient ischemia.

In several cases angiocardiography was done after premedication with either quinidine or procaine-amide to diminish the irritability of the myocardium. In these instances no abnormal rhythms appeared.

[The authors do not make a point of the fact that the abnormal rhythms which they observed appeared and in some cases persisted over precisely the period in which practically all of the deaths have occurred attributable to angiocardiography. Premedication with quinidine or procaine-amide would seem to be indicated as a routine.—Z.F.E.]

Five electrocardiograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Effect of Various Factors on the Roentgenological Determination of the Cardiac Volume. Sven Roland Kjellberg, Henrik Lönroth, and Ulf Rudhe. Acta radiol. **35**: 413–427, May–June 1951.

The object of the investigation reported in this paper was to test the accuracy of the method for the determination of the cardiac volume described by Larsson and Kjellberg (Acta radiol. **29**: 159, 1948. Abst. in Radiology **52**: 139, 1949) and by Kjellberg, Rudhe, and Sjöstrand (Acta radiol. **31**: 113, 1949. Abst. in Radiology **54**: 137, 1950). This method requires films in two planes: a prone postero-anterior and a lateral. The former is taken with the tube angled 30 degrees toward the feet. The study covered 281 subjects of various ages.

Angulation of the tube is thought to be warranted by the fact that the contours of the heart appear more clearly and a larger percentage of the whole cardiac contour is visible than with the use of rays falling perpendicularly. The calculation of the cardiac volume is obtained if it is assumed that the cross-section of the heart in a postero-anterior projection is an ellipse. By the use of several formulae and drawings it is shown that the formula for the volume will be essentially the same as for the ellipsoid, *i.e.*, the product of the three parameters and a constant.

The next step was to determine the significance of correction for magnification. It was found that there is an appreciable increase in the accuracy of the pre-

dicted cardiac volumes when allowance is made for magnification.

The investigation indicated, further, that the effect of the phase of the cardiac cycle on cardiac volume estimation was inappreciable. Examination in superficial respiration and suspended deep inspiration showed no statistical difference. Studies in the upright and prone position showed the upright volume to be 92 per cent of the prone volume. This difference in the cardiac volume showed a significant correlation to the pulse rate. When the variation due to pulse rate was eliminated, the volume was essentially the same in the two positions.

It was shown that the standard error of a single determination in the prone position is relatively slight.

Observations on the relationship of the cardiac volume to the height, weight, and pulse rate showed that the coefficient for weight had the highest degree of significance. The coefficient for the pulse rate had a lower degree of significance, whereas the coefficient for height was not significant.

In investigations in the United States the anterior surface of the heart with the patient upright has been used as a measure of heart size. The volume (as determined by the authors' technic) appeared to afford a considerably better expression of cardiac size.

Three drawings; 1 table. H. GRIFFITH, M.D.
Indiana University

Orthodiametry. H. Büchner. Fortschr. a. d. Geb. d. Röntgenstrahlen **74:** 498–511, May 1951. (In German)

A new radiologic method of heart measurement, called orthodiametry, is described. The method utilizes the possibility of parallel shift of the x-ray tube, the fluoroscopic screen, and the central x-ray beam with relation to a fixed object. A radiolucent rule with radiopaque figures is positioned behind the screen. The figures are visible on the screen, without distortion, during fluoroscopy, making possible direct measurement of the different diameters of the heart, the width of the chest, and any other desired dimensions, without the use of complicated equipment or mathematical formulae. No special preparation is required for the patient or the physician. The measuring instrument can be used without difficulty in connection with any x-ray equipment, and the measurements can be read from the fluoroscopic screen without any further correction.

Ten roentgenograms; 3 charts.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Contractile Dysfunction of the Heart in Kymography. P. Stumpf. Fortschr. a. d. Geb. d. Röntgenstrahlen **74:** 487–497, May 1951. (In German)

In so-called "vegetative dystonia," due to certain nutritional deficiencies, the kymogram of the heart may furnish objective evidence of "muscular insufficiency" or "contractile dysfunction." As compared with normal heart function, comparative kymograms taken before and after physical strain show after strain an increase of the heart size, decrease of the amplitude at the apex with slight alteration of frequency, a fixed type II or sudden change from type I to type II, augmentation of the auricular movements on the right, occasionally with bulging of the right heart border and with increase of the movements of the superior vena cava. Clinically, in most cases, only a considerably diminished heart efficiency can be demonstrated.

Seventeen kymograms.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Extensive Calcification of the Myocardium. Report of a Case. A. Carlton Ernstene and John B. Hazard. Circulation **3:** 690–693, May 1951.

An unusual case is presented, with extensive calcification of the myocardium involving predominantly the left auricle and ventricle and the interventricular septum. The heart valves and pericardium were normal, leaving the etiology somewhat obscure.

The patient died at the age of twenty-five of heart failure. She had had a severe attack of scarlet fever at nine years of age, pneumonia at twenty-one, and an acute upper respiratory infection at twenty-three, from which time the symptoms of cardiac failure dated. The authors postulate that the calcification represented the healed stage of a diffuse myocarditis associated with one of the three past illnesses.

One roentgenogram; 2 photomicrographs; 3 photographs. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Calcification of Left Auricle. P. T. O'Farrell. Irish J. M. Sc. pp. 211–212, May 1951.

A case of calcification of the left auricle was encountered in an attempt at surgery for relief of a mitral stenosis. The calcification was so extensive that the surgeons feared their sutures might not hold in the diseased tissue, and operation was abandoned. Preoperatively the calcification had been missed on x-ray examination but was easily seen on a review of the films as a curvilinear area corresponding to the superior margin of the left auricle.

Only 18 cases of calcification of the left auricle demonstrated radiologically are reported in the literature.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

THE DIGESTIVE SYSTEM

On Scleroderma with Involvement of the Esophagus. Horst Dörken. Radiol. clin. **20:** 129–135, May 1951. (In German)

A man of unstated age is said to have experienced dysphagia, a painful retrosternal pressure sensation, and arrest of food in the thorax "since 1944," though the date at which he was seen by the author is not stated. Repeated x-ray studies were said to have been negative. Swelling of the dorsal aspects of both hands occurred in 1945, resulting in an increasing flexion contracture of the fingers, with tightening of the skin in various other regions of the body. Examination, apparently later than 1948, revealed generalized scleroderma with ulcers over some of the finger tips and gastric anacidity. A barium study showed dilatation of the upper two thirds of the esophagus, narrowing of its lumen at or near the cardia, and a small hiatus hernia. Peristalsis was reduced. The roentgen diagnosis was esophageal ulcer with cicatricial constriction of the gullet. Esophagoscopy confirmed scar formation and constriction but failed to demonstrate an ulcer. The tip of the endoscope, however, could not be advanced beyond the esophageal narrowing.

A review of the literature concerning this symptom complex is included.

Two roentgenograms.

GERHART S. SCHWARZ, M.D.
New York, N. Y.

Gastric Double Contrast. Cesare Gianturco. South. M. J. **44**: 478–481, June 1951.

A method of gastric double contrast study is described in which two ounces of thick barium mixture are given. The air content of the stomach serves to give adequate contrast in 90 per cent of cases. Mineral oil is used for contrast in the remaining 10 per cent (see Radiology **55**: 174, 1950). The patient is maneuvered into different positions to coat the mucosa of various parts of the gastric wall with barium, and to provide double contrast when the walls are separated by the air or oil. Examination must be done before passage of large amounts of barium to the small bowel because this may obscure the gastric picture. The presence of food or fluid precludes success because barium will not adhere to a wet mucosa.

With the use of oil, confusion may result because of pseudo ulcer craters, polyps, or granular appearing mucosa due to oil drops or air bubbles. Such confusion is minimized with air contrast.

The gross pathology demonstrated by this method is similar to that seen on compression fields. The value of the method lies in the examination of gastric areas not accessible to compression.

Eight roentgenograms; 5 drawings.

MASON WHITMORE, M.D.
Jefferson Medical College

Hypertrophic Pyloric Stenosis, A Case Report of an Infantile Type Followed by an Adult Type. John W. Dublin and Albert E. Ady. J. Iowa M. Soc. **41**: 188–191, May 1951.

The authors' patient was an 18-year-old male with the adult type of hypertrophic pyloric stenosis developing after a successful pyloromyotomy at the age of five and one-half weeks for the congenital variety. He had been in good health after the initial operation, in 1931, until the summer of 1949, when he complained of abdominal pain. Gastro-intestinal roentgen study at this time showed an atonic and dilated stomach, constriction and deformity of the prepyloric region, and irritability of the duodenal bulb. Fifty per cent gastric retention was observed after five hours. The preoperative radiologic impression was duodenal ulcer with benign antral hypertrophy.

Operation in January 1950 revealed a mass in the pyloric region caused by thickening of the muscular wall. Histologic sections through the region revealed hypertrophy of the circular muscle fibers and inflammatory cell infiltration. The scar of the earlier operative procedure was identified. A subtotal gastrectomy was performed and recovery was uneventful.

One roentgenogram; 3 photographs.

DAVID D. ROSENFELD, M.D.
Fontana, Calif.

Prolapsing Gastric Mucosa Through Gastrojejunostomy Simulating Cancer of the Stomach. Bernard Maisel and Sidney Weintraub. Surgery **29**: 777–780, May 1951.

A 44-year-old male who had had a subtotal gastric resection and a gastrojejunostomy for a duodenal ulcer complained of epigastric and peri-umbilical pain. Roentgen examination revealed a constant filling defect, suggestive of neoplasm, at the stoma of the gastrojejunostomy. At surgery the defect proved to be due to a soft polypoid mass located on the gastric side and covered by normal gastric mucosa. The mass consisted of chronically inflamed stomach mucosa and a thickened submucosa and readily prolapsed into the jejunum through the stoma. The submucosa showed fibrosis, edema, and increased vascularity. Surgery consisted of further resection of the stomach, vagotomy, and pylorectomy (the original duodenal ulcer had never been resected). The patient remained symptom-free after two years.

Two roentgenograms; 1 photograph; 2 photomicrographs.

DAVID D. ROSENFELD, M.D.
Fontana, Calif.

Gastric Polyposis. Mark C. Wheelock, Arthur J. Atkinson, and Robert Jennings. Gastroenterology **18**: 135–137, May 1951.

The authors report the case of an asymptomatic white man, 70 years old, in whom numerous gastric polyps were visualized both radiographically and gastroscopically. There were no physical findings referable to the upper gastro-intestinal tract but an achlorhydria was present. A subtotal gastric resection was done after frozen section of several of the polyps revealed them to be benign adenomas.

Prior to 1943, records of 125 patients with three or more gastric polyps were found. The etiology of gastric polyposis is not known, but there may be some relationship with gastritis of the hypertrophic type. A definite relationship exists between polyps, or adenomas, and carcinoma, for malignant change occurs in one or more polyps in 12 to 50 per cent of all cases. The incidence of achlorhydria is high in all series reported.

One roentgenogram; 1 photograph.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Multiple Polyposis of the Small and Large Intestines with Multiple Intussusception. Report of a Case. Marshall N. Jensen. Surgery **29**: 772–776, May 1951.

The case reported here, the first of its kind to be recorded, concerns a twenty-four-year-old male whose initial complaints involved the upper gastro-intestinal tract. Anemia was present and at first was considered to be caused by rectal polyps. The initial barium meal and barium enema examinations were reported negative. The rectal polyps were removed, but the anemia persisted. Ten months later, after repeated negative sigmoidoscopic studies, a mass was seen just beyond the end of a 24-cm. proctoscope, and was partially removed by a wire snare. Because of the possibility of a malignant condition, a lower abdominal incision was made with a view to more complete removal. The sigmoid was examined, but no lesion was found. Postoperatively a barium enema study showed a large polyp which moved from the hepatic flexure to the lower descending colon, with evidence of intussusception. A barium meal showed dilatation of duodenum and jejunum. On the roentgenogram reproduced in the paper the mucosal pattern depicted is suggestive of intussusception.

A second laparotomy revealed six polyps scattered throughout the small bowel. Several of these were initiating factors in intussusceptions. In the first portion of the jejunum the intussusception involved 24 inches of the gut. A large polyp was also found attached to the middle of the transverse colon. Near this, numerous smaller polyps were present. The large polyp had apparently telescoped the transverse colon when it was seen by the proctoscope. All polyps on histologic section proved to be benign.

The author comments that intestinal tumors, in this case polyps, may lead to mild abdominal symptoms from intussusception or may cause an unexplained hypochromic anemia. In the presence of one or more intestinal polyps, careful search should be made for others.

Four illustrations, including two roentgenograms.

DAVID D. ROSENFELD, M.D.
Fontana, Calif.

Accelerated Transit Through the Intestine. Albert Hudak. Radiol. clin. **20:** 148–154, May 1951. (In French)

A method is described for accelerating passage of the barium meal through the small bowel, thereby facilitating roentgen study. A small barium meal is given (the author uses two teaspoonfuls), followed in ten minutes by a glassful of iced physiological saline; ten minutes after this, 1.0 mg. of prostigmine is injected intravenously. Ten minutes later the first roentgenogram is made. The meal reaches the cecum in one-half to two hours after the injection. Usually four or five films will complete the study.

Six roentgenograms.

CHARLES M. NICE, M.D.
University of Minnesota

Hysterical Abdominal Distention Simulating Acute Intestinal Obstruction, with Report of a Case. Philip R. Westdahl. California Med. **74:** 377–380, May 1951.

Hysterical abdominal distention may closely simulate obstruction of the bowel. In order to prevent needless laparotomy, certain clues are listed that may serve to differentiate hysterical distention from organic disease. They are (1) history of vomiting without dehydration, (2) complaint of severe pain, with normal temperature, pulse, and leukocyte count, (3) normal tympanic quality of the abdomen, (4) distention out of proportion to the amount of gas observed on x-ray examination, (5) pronounced lordosis caused by thrusting the abdomen forward, (6) remission under general anesthesia.

A case is reported in which there were numerous hospital admissions with eight verified operations for abdominal distention. On one of these occasions early obstruction was found, and it is emphasized that true obstruction can occur in these cases. Unless the diagnosis of hysterical abdominal distention can be definitely established, exploration is mandatory if the patient does not improve.

One roentgenogram; 1 photograph; 1 table.

FRANK T. MORAN, M.D.
Lancaster, Penna.

Pneumatosis Intestinalis in the Newborn. O. Arthur Stiennon. Am. J. Dis. Child. **81:** 651–663, May 1951.

Pneumatosis cystoides intestinalis is defined as an abnormal collection of gas in the walls of the intestine or its supporting structures. It is more frequently seen in the region of the terminal ileum, ascending colon, and jejunum. Pyloric stenosis, pyloric ulcer, or both, frequently accompany the condition. The duodenum is never involved. In children the major portion of gas is invariably in the submucosa. In adults, the gas may be in any of the bowel layers, but is usually subserosal. Vomiting and diarrhea have been the two most frequent symptoms in children. Most childhood cases are first diagnosed as upper respiratory infection or pneumonia.

The cysts may or may not be lined with a thin layer of "endothelium." Those with "endothelial" lining, giant-cell formation, and fibrosis appear to represent the more chronic cases.

A new mechanical theory is presented assuming that there must be a supply of gas under pressure available, which is normally found only in the stomach, duodenal bulb, terminal ileum and colon. The author feels that the gas may leave the gastro-intestinal lumen by means of a defect, such as an ulcer, spread to various areas of the intestinal tract along the mesenteric roots, then dissect along the subserosal layers or follow the blood vessels to enter the submucosa.

The roentgen findings are protean. They include a reticular appearance of the abdomen, the highly characteristic double-ring shadow, unexplained pneumoperitoneum, unusual collections of air in the vagina, retroperitoneal tissues, perirenal area, or bladder, and separation of the liver from the right leaf of the diaphragm by large emphysematous cysts. Occasionally the condition appears as an atypical ulcerative colitis, which clears rapidly.

Two cases in newborn infants are reported.

Three roentgenograms.

DAVID A. HUOT, M.D.
Mercy Hospital, Pittsburgh

Diagnosis of Early Cancer of the Large Bowel and Rectum. Norman A. McCormick. Canad. M. A. J. **64:** 403–409, May 1951.

More cancers are said to originate in the cecum, colon, and rectum than in any other system of the body. The present discussion is based upon 277 cancers of the large bowel and rectum discovered among 3,605 patients admitted to the Neoplastic Service of the Metropolitan General Hospital, Windsor, Ontario, in a fourteen-year period. In view of the lessened operative mortality and improved five-year survival rates, the importance of the recognition and adequate treatment of these neoplasms becomes increasingly apparent.

Since cancer is itself symptomless, the only present hope for its early detection lies in physical examination. For the diagnosis of rectal cancer this should begin, in women, with the vagina. Digital examination should follow, and is the most important single procedure. Ninety-one per cent of the carcinomas of the rectum in this series were palpable to the examining finger. Failure to make a digital examination was almost invariably the cause of a delay in diagnosis. For those cancers beyond reach of the finger, sigmoidoscopy is of the utmost importance. The author states that x-ray investigation plays no part in the diagnosis of cancer of the rectum. A barium enema study is often misleading. Not infrequently, readily palpable tumors are missed by the roentgenologist, with a resulting false sense of security. With the diagnosis established, however, x-ray examination may be useful in determining the extent of bowel involvement and the presence or absence

of multiple lesions. Under all other circumstances, the barium enema should be reserved for investigation of the upper portions of the large bowel in those patients in whom rectal cancer has been proved absent.

About 50 per cent of cancers of the cecum and right colon are manifest as a palpable mass by the time medical advice is sought. Barium enema study is helpful in this group, the more advanced lesions being readily detectable. Occasionally a double-contrast study will show a cancer in this area. In cancer of the left colon, the barium enema is probably the most significant part of the examination, but accurate interpretation of the roentgenologist's report should be made by the clinician in light of other findings.

Four charts; 1 drawing; 4 tables.

J. M. KOHL, M.D.
Jefferson Medical College

Intussusception in Children Under Two Years of Age. An Analysis of Fifty-Four Cases from Charity Hospital of Louisiana at New Orleans. H. Reichard Kahle. Surgery **29**: 182–195, February 1951.

Eighty-eight cases of intussusception in children under two years of age were reported from Charity Hospital of Louisiana in 1938. At that time the mortality rate was 63.6 per cent. A second series of 54 cases covering the period 1938 to 1949 shows a mortality rate of 25.9 per cent. This is still far too high for a disease which is ordinarily so clear-cut in its manifestations and which presents so few diagnostic problems. The author feels that delay before operation is chiefly responsible for the high mortality.

Nearly all patients in the series reported here had pain, bloody stools, and vomiting, and in most a definite mass could be felt, usually in the left lower quadrant. Roentgenologic examination is sometimes helpful in the diagnosis but in most cases it is not really necessary. In most cases in the present series an erect or flat plate was ordered, and in about one-half of the examinations it showed gaseous distention, fluid levels, or both. A barium enema was used for diagnostic purposes in 24 patients, in 22 of whom intussusception was demonstrated. In 2 patients the intussusception had reached the hepatic flexure and in 1 it had reached the cecum. In the remaining patients it had reached the left half of the colon, which, for anatomic reasons, is the usual limit. The exact stopping place of the intussusception does not seem a matter of great pathologic or prognostic importance.

Intussusception continues to be regarded at Charity Hospital as a surgical emergency. Reduction was effected, however, by barium enema in 5 patients in this series. In 3 of these complete reduction was produced after one or more attempts during fluoroscopy and continued freedom from symptoms seemed to make operation unnecessary. In the 2 remaining patients the fact of complete reduction was established at operation, which was performed for purposes of confirmation. Although the bowel in both cases was regarded as viable, death occurred in one patient nine hours after the operation and at autopsy gangrene of the affected segment and generalized peritonitis were found. This early death suggests that the condition of the bowel was not properly evaluated, and illustrates one of the dangers inherent in this method. Ravitch and McCune, from experimental and clinical evidence, believe that it is not possible to reduce gangrenous bowel by the hydrostatic pressure employed in the proper use of the barium enema method (J. Pediat. **37**: 153, 1950. Abst. in Radiology **57**: 136, 1951).

The author apparently applied the barium enema method in all of his last 10 cases without mortality. He does not mention whether any of these were submitted to operation. The method must be used with every possible precaution. All manipulations must be gentle. The hydrostatic pressure must not be more than 3 feet; nor should more than three attempts at reduction be made. If fluoroscopic evidence of success is not apparent after the third, operation should be resorted to without delay, and in many apparently successfully treated patients it would be wise to investigate the ileocecal region through a McBurney incision. The cardinal consideration in any attempt at hydrostatic reduction is that the patient should be in the hands of the surgeon before, not after, it is made.

This is a complete and well written treatise, and those interested in the subject should read it in its entirety.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Volvulus of the Sigmoid Colon. R. M. Pool and W. David Dunavant. Ann. Surg. **133**: 719–724, May 1951.

Volvulus of the sigmoid is a rather rare cause of intestinal obstruction. The authors found volvulus of the sigmoid in 3 per cent of a series of 522 cases of intestinal obstruction and in 33 per cent of 48 colon obstructions. The etiology is obscure, but one factor is invariably present, namely, a redundancy of the sigmoid colon, either congenital or acquired. Megacolon is generally recognized as a contributing factor. The twist of the mesenteric base and the axial rotation of the bowel are together responsible for the obstruction. The axial rotation is twice that of the mesenteric twist; thus, the axial rotation is 360 degrees in a volvulus of 180 degrees. The rotation may be either clockwise or counter-clockwise. The amount of rotation necessary to produce obstruction varies; it was at least 180 degrees in all of the authors' cases.

The obstruction is of a closed loop type, the pathologic changes being produced by distention of the bowel with gas and fluid. The torsion serves as a valve which allows air and fluid to enter the closed loop but not to escape. Occasionally, however, air and fluid are forced from the closed loop, giving rise to diarrhea despite the obstruction. The blood supply usually remains adequate for a few days. As the obstruction persists, the proximal colon is gradually distended, at times even to the cecum. If the ileocecal valve is patent, the small bowel may also become distended.

The symptoms vary widely. The onset is usually insidious, with slight abdominal pain followed by obstipation and distention. One-third of the authors' patients had previously experienced similar attacks, these having been relieved at home by enemas and purgatives. Those with gangrene complained of constant but not severe pain. In the others pain was not pronounced and usually was not the chief symptom. All of those with gangrene and about 75 per cent of those without gangrene had leukocytosis of some degree.

Two roentgen signs were observed in 13 of the 16 cases. First, the sigmoid was tremendously distended, more than is ordinarily observed with other types of obstruction, while the remainder of the colon was only moderately distended. The sigmoid extended upward and to the right, usually reaching the edge of the liver

or diaphragm. Second, the distended colon contained large quantities of fluid and gas. The "bent inner tube" picture was observed in 8 cases, *i.e.*, the ascending and descending segments were adjacent and were filled with fluid and gas.

The authors believe that surgery is the treatment of choice and they favor the simplest procedure possible, namely, untwisting of the volvulus and deflation of the colon per rectal tube. To insure continued deflation during the first twenty-four hours, they recommend dilatation of the rectal sphincter while the patient is under the anesthetic. To effect a cure, the redundant sigmoid should be resected later, preferably with an end-to-end anastomosis. The most suitable time for resection is six to twelve weeks after the original operation.

Two roentgenograms. J. DUDLEY KING, M.D.
Crawford W. Long Hospital
Atlanta, Ga.

Mucocele of the Appendix. David Stanley Likely and Condict Walker Cutler, Jr. New York State J. Med. **51:** 1181–1182, May 1, 1951.

The authors present the case of a 54-year-old white male in whom a large abdominal tumor was discovered on physical examination. This firm mass extended up out of the pelvis to the level of the umbilicus and was described as giving the patient a "contour of a seven-month pregnancy." There were no symptoms that could be referred to the abdomen except a moderate degree of constipation.

Cystoscopy and a cystogram showed the bladder to be compressed downward and to the right. A barium enema study disclosed displacement of the sigmoid and descending colon to the left. An intravenous pyelogram revealed partial obstruction of the right ureter.

At surgery a large retroperitoneal cyst was found continuous on the right with the appendix and mesoappendix. The cyst wall was also attached to the sigmoid, making surgical removal difficult. A thick gelatinous material escaped from the cyst when it was accidentally ruptured. The pathologist's report following microscopic study was mucocele of the appendix.

The diagnostic points stressed are the cystic nature of the mass, absence of tenderness, and the location in the lower abdomen. The radiographic studies showed it to be extrinsic to the lumen of the colon and also that it exerted extrinsic pressure on the bladder and right ureter.

Two roentgenograms; 1 drawing.
DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Oral Cholecystography: Critical Review of 200 Operated Cases. Hugh P. Smith, Jr., and Tom M. Runge. Gastroenterology **18:** 49–54, May 1951.

The authors have made a study of the surgical and radiographic findings in 200 patients operated upon with the diagnosis of gallbladder disease. In 17 of the cases no cholecystographic study was performed because opaque gallstones were shown on the plain films. In all of the others the gallbladder was examined following the ingestion of twelve 0.5 gram tablets of priodax (Schering).

In 118 cases, or 59 per cent of the series, gallstones were diagnosed radiographically. In 117 of these (99 per cent), stones were demonstrated at surgery. In 61 other patients gallstones were found at surgery which were not shown on the films. Of this group of 61 patients, 45 had non-visualizing gallbladders.

In 71 patients the dye failed to outline the gallbladder. In 2 of these, milk of calcium bile was present. In 19 patients, opaque calculi were seen. One of these also showed milk of calcium bile. In 50, no stones or gallbladder shadow could be identified. At operation, calculi were demonstrated in the gallbladder or biliary passages in 64 (90 per cent) of these patients.

The response of a fatty meal was also checked routinely. It is interesting to note that in 78 patients with diseased gallbladders, contraction occurred in 52, while only 26 showed no gallbladder contraction.

Two tables. DEAN W. GEHEBER, M.D.
Baton Rouge, La.

On the Relationship Between the Excretion of Sodium Tetraiodophenolphthalein and Non-Opacification of the Gallbladder. Z. Zsebök, T. Kozma, and B. Láng. Radiol. clin. **20:** 135–144, May 1951. (In German)

Fifty patients of both sexes who underwent intravenous cholecystography were examined for iodine retention in the plasma one hour and twelve hours after injection of 60 mg. of the medium, Cholumbral. Another 10 patients were examined similarly at hourly intervals up to seven hours after injection. It was found that in cases with normal visualization of the gallbladder the iodine content of the plasma dropped, on an average, to one-third of the one-hour reading within ten hours. All cases (20) with a twelve-hour iodine retention of 32 per cent of the one-hour value or more (highest twelve-hour value, 89 per cent) showed either non-visualization or faint visualization of the gallbladder.

In 5 cases the cholecystogram was repeated seventy-two hours later. Visualization of the gallbladder was unchanged in every instance (one good, one faint, three none). The plasma iodine values of the second examination likewise deviated little from those originally observed. In all 8 patients with a non-visualizing gallbladder, a repeat film was taken four hours after the standard fifteen-hour film. In an unstated but apparently large percentage of these cases the second film revealed opacification of the gallbladder.

Six patients were operated upon. The operative findings are discussed.

The authors arrive at the following conclusions:

1. Non-visualization of the gallbladder can be caused by too slow excretion of the contrast material by the liver as judged by prolonged iodine retention in the blood plasma.

2. A twelve-hour film should be followed by an eighteen-hour film if the gallbladder is not visualized.

3. The assumption seems justified that sodium tetraiodophenolphthalein itself may sometimes cause a neurovegetative liver block leading to non-visualization of the gallbladder.

4. For any given case, the rate of iodine clearance from the plasma remains essentially the same on different occasions.

[This is a very good piece of work. There is, however, a serious typographical error in Table II. The heading of the eighth column should read 12 hours instead of 1 hour.—G.S.S.]

Three tables. GERHART S. SCHWARZ, M.D.
New York, N. Y.

Operating Room Cholangiograms. Arthur Zierold. Minnesota Med. **34**: 439–441, May 1951.

Postoperative biliary obstruction is an embarrassing and serious experience for the surgeon. It is most often due to a duct stone that has been overlooked. To avoid this, the common duct may be explored at the time of operation, but Lahey reported an increase in the mortality rate from 4 to 13 per cent when such exploration was undertaken. Cole, reviewing many series of cases, found an over-all mortality of 6.5 per cent after gallbladder operation, rising to 10 per cent with duct exploration.

Operating room cholangiograms will furnish evidence of the presence or absence of stones in the duct without added risk. With the patient on the operating table with a tunnel sufficiently deep to hold a cassette under the gallbladder region, a film is obtained preoperatively to check for exposure, technic, and location. The gallbladder is then removed and a small probe is inserted in the cystic duct to determine its patency. A soft silver cannula is then inserted into the cystic duct and tied firmly with catgut. A Luer syringe is attached to the cannula by means of rubber tubing, the biliary tract is irrigated with saline (20 c.c.), and diodrast, full strength or in 50 per cent solution, is slowly injected. Meanwhile the anesthetist has produced a state of apnea by the use of oxygen and forced respiration. At a given signal he stops respiratory motion and the film is taken, followed immediately by another. The factors usually employed are 80 kv., 40 ma., 30 inches distance with cone attached, 0.7 second exposure.

The films are developed immediately and viewed in the operating room. If a stone or abnormality of the duct is present, the common duct is exposed for exploration. At the end of the exploration a T-tube is put in place and sutured. Irrigation is again done, diodrast is injected, and films are obtained.

Lipiodol was at one time used for the opaque medium, but air bubbles were found to cause difficulties in interpretation. Thorotrast was also used but caused irritation in the event of spilling into the peritoneal cavity.

Three roentgenograms. JOSEPH T. DANZER, M.D.
Oil City, Penna.

Diaphragmatic Deformation of the Liver. G. S. Christie. Australian & New Zealand J. Surg. **20**: 289–303, May 1951.

This paper deals with one of the commonest of liver deformations, the presence of single or multiple regular grooves penetrating the upper surface. The grooves may occur on either lobe, but are much more frequent on the right (9 to 1). The commonest number is three. Anteromedial members of a group are more numerous than the posterolateral ones and are usually deeper, longer, and further apart, although there is great variation in this respect. The largest number observed in the right lobe in the author's series was seven. The average number increases with age. No constant abnormality of the peritoneum, liver capsule, or parenchyma under the grooves or over the intervening ridges could be found.

The author describes also a diaphragmatic "boss" of the liver, consisting of an elevation on the anterosuperior surface of the right lobe, and a diaphragmatic liver "hump," occupying almost the whole lateral extent of the anterosuperior border. In common with the more frequent grooves, bosses and humps are confined to the part of the liver underlying the muscular part of the diaphragm which arises from the ribs and costal cartilages.

Non-diaphragmatic deformities of the liver to be distinguished from diaphragmatic grooves include costal impressions, clefts due to peritoneal folds, clefts due to local scarring, grooving by a loop of bowel, and fissures of the inferior surface

The incidence of diaphragmatic deformity as identified radiologically is lower than that found at autopsy. The normally smooth uniform contour of the diaphragm is sometimes segmented into two or more overlapping arcs, each arc forming a regular curve. *Multiple arc contour* is due to the presence of several long parallel grooves as commonly seen postmortem. The arcs overlap since they correspond to elongated ridges directed obliquely downward, forward, and laterally and therefore partially superimposed in an anteroposterior view. A *double-arc contour* is commoner radiologically than multiple arc formation, but is similar, inasmuch as each of the segments appears as a smooth regular curve.

Muscular slips arising from the ribs, especially the 10th and 11th, are sometimes visible on the chest film. They have a straight upper border, may be traced accurately to the ribs and run slightly upward and inward forming a set of steps. Increased costal obliquity or a horizontal position of the diaphragm exaggerates the serration of the lateral part of the line of origin.

In a series of 900 consecutive adult autopsies, the incidence of grooving was found to be 11.4 per cent.

Eleven photographs, 2 roentgenograms, 2 diagrammatic drawings; 2 tables. DANIEL WILNER, M.D.
Atlantic City, N. J.

THE MUSCULOSKELETAL SYSTEM

Growth of the Shaft of the Human Radius and Ulna During the First Two Years of Life. Musa K. Ghantus. Am. J. Roentgenol. **65**: 784–786, May 1951.

The material for this study of the growth of the radius and ulna was obtained from the Brush Foundation, Western Reserve University, and consisted of radiographs of children of three, six, nine, twelve, eighteen, and twenty-four months of age. One hundred films were studied for each age group in each sex, 1,200 films and 2,400 measurements in all. The distance from the proximal end to the distal end of the shadow of the shaft was determined to the nearest 0.5 mm. with a "Flower craniometer." The findings are summarized in a table. A study of this table shows that the shafts of the radius and ulna in the male are consistently longer than in the female of the same age. The average rate of growth per month decreases consistently with increasing age. During the first post-natal year the average increase in length of the radius and ulna is greater in the male. During the second year the average increase is greater in the female.

I. MESCHAN, M.D.
University of Arkansas

Appearance of Centers of Ossification in the Human Pelvis Before Birth. Carl C. Francis. Am. J. Roentgenol. **65**: 778–783, May 1951.

The centers of ossification in the pelvis were studied in a total of 640 normal embryos and fetuses of known size, sex, and color. The specimens were divided into

nine groups in accordance with crown-to-rump length.

The primary center of ossification for the ilium was seen in every fetus having a crown-rump length of 61 mm. or more, and appeared to have assumed a rather characteristic shape by 130 mm. This primary center should be distinguishable on a roentgenogram of a fetus with a crown-to-rump length of about 60 mm. The time of the appearance does not seem to vary with sex or color.

The primary ossific center for the ischium was present in every fetus with a crown-to-rump length of 135 mm. or more. It is therefore concluded that this center should be visible when the fetus attains a crown-to-rump length of 130 to 140 mm.; it does not appear earlier in the female than in the male.

A primary ossification center for the pubis was present with measurements of 340 mm. or more, with a tendency to earlier appearance in the female than in the male. Color is not a factor. In view of the high incidence of the appearance of this primary center of ossification in even smaller fetuses, it is concluded that it should be present radiographically in female fetuses of about 160 mm. crown-to-rump length and in male fetuses a few millimeters longer.

With regard to the ossification centers in the centra of the sacral vertebrae, the upper three should be present in fetuses of 80 to 90 mm. crown-to-rump length. The fourth should be present at about 160 mm., and the fifth at 200 mm. The latter is quite variable in its appearance and may actually be unossified at birth.

Ossific centers appear in the transverse processes of the first sacral vertebra very soon after the centrum begins to ossify, and centers ossify in the transverse processes of the other sacral vertebrae in order, from above downward, usually a little later than the time of onset of ossification in respect to the centra.

All standard texts seem to agree that 3 pairs of ossific centers appear in the lateral mass of the sacrum before birth. The centers appear in order from above downward. The first pair should be present at a crown-to-rump length of 210 mm., the second at about 280 mm., and the third at about 340 mm. There is no relation to sex or color.

The coccygeal segment should be ossified at birth.

Occasionally there is an asymmetry of the appearance of ossific centers in those portions of the pelvic girdle which are paired. This is particularly true at the very earliest time of appearance of ossification. This asymmetry is not related to laterality, sex, or color.

Six tables. I. MESCHAN, M.D.
University of Arkansas

Infantile Cortical Hyperostoses. John F. Bowser. J. Kansas M. Soc. **52**: 209–212, May 1951.

Infantile cortical hyperostoses, first described as a new syndrome by Caffey in 1945, is an uncommon condition of wide geographic distribution. Although cases have been reported from such widely separated places as New York, San Francisco, the Netherlands, and China, it is interesting to note that a single case formed the basis for six publications. In this article the author reports what he states to be the twenty-sixth case to appear in the literature, and summarizes the previous writings.

The patient was a four-months-old female who had had a deformity consisting of forward bowing of the left shin at birth. Roentgenograms of the lower extremities when the baby was five weeks old were "suspicious for scurvy or some obscure pathology of long bones." A high-vitamin antiscorbutic diet did not result in any improvement, and the condition progressed. Subsequent x-ray studies showed typical cortical hyperostosis of the mandible and involvement of both upper and both lower extremities.

This case may represent the earliest onset of the disease on record if the tibial deformity which was present at birth was indeed cortical hyperostosis, as seems likely in view of the advanced state of the condition found roentgenographically at five weeks of age.

Four roentgenograms. SIDNEY KING, M.D.
Chicago, Ill.

Infantile Cortical Hyperostoses. Report of Case and Summarization and Evaluation of All Other Reported Cases. Leonard M. Rapoport. Arch. Pediat. **68**: 238–244, May 1951.

At the time it was studied and reported, the case recorded here was believed to be the fourteenth example of infantile cortical hyperostoses to reach the literature. The patient was an 18-weeks-old female who had had recurrent tender swellings of mandibles, right wrist, and forearm for four weeks. Examination on hospital admission revealed a smooth, firm enlargement of the distal third of the right ulna. The patient was afebrile, with mild anemia and a slightly elevated sedimentation rate. Other laboratory findings were not remarkable. Roentgenographic findings consisted of "an irregular periosteal reaction" and a small area of cortical erosion of the distal part of the right ulna. Other bones examined, including skull, mandible, and extremities, showed no involvement. The thymus was enlarged. The hospital course was uneventful, and the patient was discharged with no specific therapy.

The history of the recognition of the entity is discussed, and the principal clinical, laboratory, pathologic, and roentgen features of the condition are reviewed.

SIDNEY KING, M.D.
Chicago, Ill.

An Atypical Case of Infantile Cortical Hyperostoses. Ian D. Kitchin. J. Bone & Joint Surg. **33-B**: 248–250, May 1951.

The case of infantile cortical hyperostoses reported here presented several unusual features: the family history, early onset, marked anterior tibial bowing, and absence of evident malaise, fever, or tenderness.

The films at birth showed gross thickening of both tibiae and, in the lateral views, well marked anterior bowing and subperiosteal masses. At ten days of age a diagnosis of subperiosteal hemorrhages of unknown origin was suggested. At this point the child's maternal grandmother volunteered the information that the child's mother had had, at birth, exactly similar deformities which were also diagnosed as subperiosteal hemorrhages of unknown origin. These deformities had disappeared entirely in the first few years of life. Unfortunately the records had been lost.

The child's films were then reviewed by Sir Thomas Fairbank, who made the diagnosis of infantile cortical hyperostoses. Progress was uneventful. The patient gained weight at a normal rate and at all times looked fit and well. Radiographs taken eight weeks after birth showed the condition very clearly; it was confined to the tibiae. Anterior bowing was pronounced, but remodelling was already well advanced. At the age of

one year there was still marked anterior bowing and slight lateral bowing of both legs. Radiographs showed, also, further remodelling with buttressing along the concave sides of the bones, and transverse dense bands, seen most clearly in the lateral views.

Ten roentgenograms. DANIEL WILNER, M.D.
Atlantic City, N. J.

Osteopetrosis (Marble Bones). Report of a Case with Special Reference to Early Roentgenologic and Pathological Findings. Ellsworth Kneal and L. R. Sante. Am. J. Dis. Child. **81**: 693–707, May 1951.

Osteopetrosis is characterized by an increase in the size and number of bone trabeculae with excessive calcareous deposits resulting in thickened and sclerotic bone structure. The cause is unknown, but there is a strong familial tendency and consanguinity apparently plays a role in some instances. Gradual encroachment of the sclerotic bone on the medullary canal results in progressive anemia. Laboratory studies seldom indicate other significant alterations from the normal.

Diagnosis depends on the roentgen manifestations. As a child grows, the sclerosis is noted first in the metaphysis, subsequently extending through the diaphysis. Parallel longitudinal striations appear in the cancellous ends of the bones, which show widening at these sites. In the fully established cases, all the bony parts assume a dense structureless appearance. The blood supply to bone is depleted, resulting in spontaneous infractions, especially in the femoral neck and the upper ends of the tibial condyles, with coxa vara and genu valgum deformities. Multiple fractures are frequent. Involvement of the skull and encroachment upon the cranial orifices may lead to such secondary changes as optic atrophy and deafness. Diseases which occasionally accompany osteopetrosis are Hodgkin's disease, lower jaw infection, bone sarcoma, and rickets. In the infantile stage differentiation must be made from rickets, scurvy, congenital syphilis, excess vitamin D administration, heavy metal poisoning, and acute infantile cortical hyperostosis. Hypothyroidism, fluorine poisoning, and myosclerosis must also be considered.

A case report is included of a white girl of three and a half months, from an area with a high fluorine content in the drinking water. Roentgen examination showed increased density particularly in the diaphyseal regions. Bone biopsy revealed soft bones which microscopically showed osteoblastic activity and considerable replacement of the marrow cavity by a loose vascular infiltration. Later a fracture occurred at the site of biopsy. There was a slight anemia, with leukopenia. The patient had been followed for ten years, with gradually increasing density of the bones, infractions of the femoral necks with coxa vara deformity, and clubbing of the ends of the long bones. Progressive deafness occurred but there was no evidence of optic involvement.

No treatment has been found to be effective, but improvement of anemia was noted in this case with iron administration, dietary and hygienic measures.

Eleven roentgenograms; 2 photomicrographs.
DAVID A. HUOT, M.D.
Mercy Hospital, Pittsburgh

Osteoporosis, A Review. Paul W. Berney. J. Iowa M. Soc. **41**: 182–184, May 1951.

Osteoblasts in normal bone are continually building a protein matrix, wherein a calcium-phosphorus-carbonate salt is deposited. Osteoporosis is defined as a decrease in bony density resulting from conditions which interfere with this matrix formation. Any of three basic mechanisms may cause this interference (Albright: Ann. Int. Med. **27**: 861, 1947. Abst. in Radiology **51**: 757, 1948): lack of stress and strain, protein deficiency, and steroid imbalance. The author discusses briefly the relation of these factors to the different types of osteoporosis—postmenopausal osteoporosis, senile osteoporosis, idiopathic osteoporosis in the young, and the osteoporosis associated with such conditions as Cushing's syndrome, hyperthyroidism, diabetes mellitus, etc.

Symptoms of osteoporosis vary over a wide range—from none at all to severe. The first complaints are usually weakness and back and hip pain. Roentgen examination usually verifies the diagnosis of compression fracture of one or more vertebral bodies. In the dorsal region this results in a wedge-shaped deformity, while in the lumbar region there is a tendency to general crushing. By this time the density of the vertebral bodies may be so slight that only their faint outline can be seen on the films. Their opposing surfaces are concave, more so in the lumbar region. Porosis is less severe in the cervical area, pelvis, and upper femurs. The extremities are involved only in severe cases. The skull and lamina dura are normal.

The most helpful positive laboratory findings are the elevated urinary calcium and phosphorus levels. This elevation is present during active phases of decalcification. When the involved bones are largely decalcified, the levels are normal or low. Serum calcium is normal, but when a large part of the skeleton is immobilized, it may be high. The routine use of the Sulkowitch test for urinary calcium will facilitate earlier diagnosis. Differentiation from other conditions causing a decrease in calcium density depends on the radiographic manifestations and on the blood chemistry (See Flink: Radiology **50**: 72, 1948).

Treatment of the post-menopausal and senile types includes adequate diet with supplemental vitamins C and D. Estrogens and androgens are used as recommended by Albright and his associates. Since prolonged use of estrogens might accelerate the growth of a cancer of the female sex organs, these should be examined before and every six months during estrogen therapy. Interval examinations are also indicated in the elderly male receiving testosterone, since prostatic enlargement may occur. DAVID D. ROSENFELD, M.D.
Fontana, Calif.

Melorheostosis: Forme fruste. W. Brauer. Fortschr. a. d. Geb. d. Röntgenstrahlen **74**: 562–565, May 1951. (In German)

In a 29-year-old woman, enlargement of the little finger of the left hand was observed. X-ray examination showed typical melorheostosis of the three phalanges of the finger, of the fifth metacarpal, and of the hamate and the triquetrum bones. In the entire skeleton no other bone changes were noted. The mother of the patient stated that the enlargement of the finger was not present at birth but dated back to the second year of life. No melorheostotic changes could be demonstrated in any siblings of the patient.

The author considers the term "osteosis eburnisans monomelica" (which is frequently used for these *forme fruste* cases) as incorrect. Definite conclusions regarding the etiology or classification of the disease are as yet

impossible. The only conclusion which so far appears justified is that melorheostosis is an anomaly of the osseous system.

Three roentgenograms; 1 photograph.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Atypical Hurler's Syndrome. A Report of 3 Cases with a Discussion of the Differential Diagnosis. Gregers Thomsen and Jørgen Vesterdal. Acta radiol. **35**: 331–344, May-June 1951.

Typical cases of Hurler's syndrome present rather characteristic findings, including dwarfism, hepatosplenomegaly, mental retardation, impaired hearing, and corneal opacity. The head is large, there is kyphos deformity of the spine, and the hands are broad and claw-like. Roentgenographically, pronounced skeletal changes are observed. The skull is enlarged and often thick-walled; the sella is large and deep, and there is hypertelorism. A characteristic kyphosis is present in the upper lumbar spine. The extremities are short and broad, and the epiphyses often deformed. The ribs are broad and club-shaped.

Three atypical cases are described here. None of these patients had corneal opacities and none was a dwarf. One was normal mentally. The radiographic findings were sufficient, however, to warrant a diagnosis of Hurler's syndrome.

Differential diagnosis in these unusual types may be difficult, particularly differentiation from hypothyroidism, hypoplastic chondrodystrophy, and Morquio's disease. Much greater bone retardation is seen in those cases of hypothyroidism where lumbar kyphosis and thickened bones occur, than is present in Hurler's syndrome. Achondroplasia differs in the clinical findings. Morquio's disease also differs clinically from Hurler's syndrome, and marked metaphyseal irregularities are present which are not seen in the latter condition.

The authors conclude that the most constant findings in Hurler's syndrome are: grotesque appearance, claw hands, hepatosplenomegaly, skull changes, broad club-shaped ribs, lumbar kyphosis, and thickened, dense, coarse bones of the extremities. Several of these signs must be present to justify the diagnosis.

Thirteen roentgenograms; 2 photographs.

RICHARD A. SILVER, M.D.
Indiana University

A Case of Renal Rickets Simulating "Metaphysial Dysostosis." G. M. Müller and H. A. Sissons. J. Bone & Joint Surg. **33-B**: 231–239, May 1951.

A case is described in which a clinical diagnosis of metaphyseal dysostosis was made, but in which histologic examination of involved bones showed the changes of rickets, presumably renal, with secondary hyperparathyroidism.

Radiographically, the "fluffy" appearance of the epiphyses of the long bones and the abnormal subperiosteal bone seen in the ulna and femur were consistent with the diagnosis of renal rickets. Histologically, the retardation of epiphyseal growth, masses of degenerated cartilage in the metaphyses, and the scattered lesions of osteitis fibrosa present in all regions of the bones studied, are also characteristic of the type of "rickets" seen in renal disease with a high degree of secondary hyperparathyroidism.

Thirteen roentgenograms; 2 photographs; 6 photomicrographs.

DANIEL WILNER, M.D.
Atlantic City, N. J.

Periarticular Calcifications. Giovanni Gardella. Radiol. med. (Milan) **37**: 362–380, May 1951. (In Italian)

The author presents 3 cases of periarticular calcifications of the ankle and shoulder. These cases were followed over a period of years and considerable change in the size and appearance of the calcifications were shown by serial roentgenograms. The author states that periarticular calcifications should be differentiated into two classes, one involving the tendons and bursa and the other involving the articular ligaments. He stresses the importance of roentgen therapy and of diathermy in the treatment of these cases.

Nineteen roentgenograms; 3 drawings; 1 table.

CESARE GIANTURCO, M.D.
Urbana, Ill.

Indications for Contrast Visualization of Space-Occupying Processes in the Spinal Canal. Georg Häussler. Fortschr. a. d. Geb. d. Röntgenstrahlen **74**: 525–535, May 1951. (In German)

In view of the disadvantages of iodized oils (iodipin), the use of other contrast media in myelography is preferable. Such media should be excreted from the body and should not cause arachnoiditis. In the region between the 12th dorsal vertebra and the 4th lumbar vertebra, air myelography may produce satisfactory results. In the region of the lumbar spine, peridurography with perabrodil may be valuable in the diagnosis of tumor; generally, however, abrodil myelography is superior in this region. In the cervical spine and the upper portion of the dorsal spine, iodized oil myelography cannot as yet be altogether discarded, although in some cases, the so called "high peridurography" may be satisfactory. The author considers abrodil in 20 per cent solution the best contrast medium for myelography at the present time, although he admits that it cannot be deemed ideal.

Sixteen roentgenograms.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

X-Ray Examination in Lumbar Disk Prolapse by Means of Kovács Lumbo-Inguinal Projection. P. Kröker. Fortschr. a. d. Geb. d. Röntgenstrahlen **74**: 512–521, May 1951. (In German)

The author takes issue with the assertion that x-ray examination without employment of an opaque medium is of little value in the diagnosis of protrusion of the intervertebral disks. He claims to be able to diagnose a high percentage of such cases producing sciatic symptoms by visualization of dorsal or dorsolateral spurs by the so-called Kovács method (see Absts. in Radiology **55**: 460, 923, 1950). The technic is as follows. The patient lies on the affected side with the pelvis tilted ventrally toward the x-ray table in such a manner as to form an angle of about 60 degrees in relation to the table plane while the thorax retains a strictly lateral position. The central ray, passing at an angle of 15 to 30 degrees in cranio-caudal direction, is aimed at the 5th vertebral interspace. The original angle of the central ray (25 to 30 degrees according to Kovács' original instructions) is so varied that it always forms a

cranially open angle of 15 degrees with the communicating line of the spinous processes of the last lumbar vertebra. The ray projection proceeds from the vertebral column to the opposite inguinal region. It is determined by the level of the opposite posterosuperior iliac spine or a point about two finger widths posterior to this iliac spine. By the demonstration of dorsal or dorsolateral marginal spurs, which according to the author are pathognomonic for prolapse of longer standing, not only simple but frequently multiple unilateral or bilateral protrusions of the disks can be diagnosed.

Twelve roentgenograms; 3 drawings.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Actinomycosis of Bone with Special Reference to Infection of the Vertebral Column. V. Zachary Cope. J. Bone & Joint Surg. **33-B:** 205–214, May 1951.

Forty-seven examples of actinomycotic infection of the spine were collected from the literature by Meyer and Gall in 1935 (J. Bone & Joint Surg. **17:** 857, 1935). Fifteen cases have since been published, and these the author presents in summary, adding 3 previously unreported cases. These with an example recorded by Brett (see following abstract) bring the total to 66 cases.

Bony tissue reacts to the actinomycotic infection in an interesting and characteristic way, differing in some respects from that in other forms of bony infection. Immediately around the focus of infection there is absorption of bone, while beyond that the bony cells are stimulated to form new bone, sometimes of considerable density. This combination of caries and sclerosis in differing proportion gives rise to many clinical types. Sequestration is uncommon. Sometimes a large bony tumor may be formed. On two occasions, the author has operated on human mandibles in which the bone was an inch thick and was traversed by a series of channels or sinuses in which the fungus was found. Sometimes (rarely) rarefaction predominates over sclerosis, as in the case of a girl who had an abscess in the lower jaw contained in a smooth-walled cavity which on external pressure gave the sensation of egg-shell crackling.

With rare exceptions bone is affected by spread from neighboring soft-tissue foci. The spinal column lies in the path of extension of several common foci of actinomycosis; a deep cervical phlegmon, an extending mediastinal infection, a retroperitoneal infiltration after perforative appendicitis, or a perforated peptic ulcer may each or any of them provide the source of spinal infection.

The disease may be limited to one vertebral body but more usually affects several vertebrae, sometimes involving a large extent of the column, for the suppuration may spread under the anterior common ligament. The intervertebral disks are exceptionally affected. Unlike tuberculosis, actinomycosis often involves the adjacent pedicles and transverse processes and also the heads of the neighboring ribs.

Rarefaction and sclerosis are found in varying proportions. In the early stages and in milder cases there may be merely absorption of the superficial part of the vertebral body and some deeper rarefaction limited by slight sclerosis. When the disease, either by continuous extension or by vascular embolism, involves the whole vertebral body the picture is characteristic. The vertebra is riddled by a network of suppurating channels which are bounded by bone of increased density—a sort of honeycomb effect which shows up like latticework on a radiograph. When the disease is progressing, rarefaction is more prominent, but as improvement takes place sclerosis dominates the picture, so that repeated and regular roentgen examination will tell the surgeon the effect of his treatment. Because of the formation of the dense trabeculae, it is uncommon for the vertebral body to collapse.

Actinomycosis can generally be distinguished from tuberculosis of the spine by the following facts: the intervertebral disks are usually spared; transverse processes and heads of neighboring ribs are often attacked; collapse of a vertebral body and kyphosis are uncommon; sclerosis is generally mingled with rarefaction, and a radiograph may reveal the lattice pattern. In both actinomycosis and tuberculosis large abscesses may lie near the column, but, whereas the tuberculous abscess travels outward from the vertebra and follows definite routes along the psoas or backward along the ribs, the actinomycotic abscess which travels from the adjacent tissues to attack the vertebral column has no definite pointing place, though it usually comes to the surface posteriorly.

Septic osteomyelitis of the spine has a more acute onset and may give rise to the formation of sequestra, an occurrence almost unknown in spinal actinomycosis. Rarefaction of the bodies is also seen in osteitis deformans and in fibrocystic disease, but here there are no general manifestations (fever, wasting, anemia) of chronic inflammation. Secondary growths in the vertebrae usually cause much greater pain, especially on movement, paraplegia is more common, and the general symptoms of suppuration are absent.

The essential treatment is the administration of one of the antibiotics (preferably penicillin) and the sulfonamides.

Four roentgenograms; 1 color plate; 1 photograph.

DANIEL WILNER, M.D.
Atlantic City, N. J.

Advanced Actinomycosis of the Spine Treated with Penicillin and Streptomycin. Report of a Case. M. S. Brett. J. Bone & Joint Surg. **33-B:** 215–220, May 1951.

A case of actinomycosis in a man of 42 years has been placed on record because the vertebral column was mainly affected and because of the remarkable response to treatment with penicillin.

Roentgenograms of the spine showed irregular destructive changes in all the vertebral bodies from T-4 to L-1. There was also evidence of new bone formation, most marked on the adjacent surfaces of the vertebral bodies. The intervening disk spaces were slightly narrowed. There was a cavity in the upper posterior part of the body of the first lumbar vertebra.

Penicillin was given in doses of half a million units twice daily by intramuscular injection, a total of 140 million units being given in twenty weeks. After two weeks of treatment, the pain in the back had completely disappeared—for the first time in four years. There was a full range of painless movement of the left hip without evidence of spasm of the psoas muscle. Sinuses on the back were either healed or covered by crusts. After nine weeks treatment, edema, which had been generalized, was confined to the ankles, and the sinuses were soundly healed. There was no change in the kyphosis, but the lower spine moved almost fully and without pain.

Since the organism was very sensitive to streptomycin, it was decided to give a three weeks course of that drug (0.5 gm. twice daily) despite the great benefit that had already been gained from penicillin. At the end of the course the patient was discharged feeling very well, and at the time of the report was able to do a full and strenuous day's work without symptoms. Roentgenograms meantime have shown striking evidence of reparative new bone formation.

Four roentgenograms; 3 photographs; 2 photomicrographs; 1 table.

DANIEL WILNER, M.D.
Atlantic City, N. J.

Tuberculostatic Treatment of Foci in Spinal Tuberculosis. J. Kastert. Fortschr. a. d. Geb. d. Röntgenstrahlen **74:** 535–543, May 1951. (In German)

A new method for the treatment of tuberculous spondylitis is described. In principle it consists of a combination of surgical removal of the tuberculous focus and postoperative tuberculostatic treatment. Four stages constitute the course of treatment: (1) Opening of an operative passage to the affected vertebral body by means of removal of the transverse process of the vertebra. In the region of the thoracic spine, instead of transversectomy of the vertebral process, transversectomy of the respective rib is done. (2) Determination of the location of the diseased focus in the bone (abscess, cavity). (3) Radical removal of the focus (by chisel, curettage, irrigation, suction). (4) Drainage by means of a rubber catheter and postoperative focal therapy with streptomyocin, PAS, or conteben. The results may be noted in some cases immediately after operation, in other cases only after three weeks. So far the results have been astonishingly good. The body temperature and sedimentation rate become normal; the general health improves rapidly, and pains of even long duration disappear. In view of the relatively short period of observation, no definite conclusions are as yet possible about the final bone healing.

Seventeen roentgenograms; 1 drawing; 1 table.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Paratyphoid Spondylitis with Paravertebral and Epidural Abscess. Report of a Case. H. W. Sung and H. C. Tseng. Chinese M. J. **69:** 210–217, May-June 1951

Spondylitis caused by bacilli of the typhoid-paratyphoid group is a rather rare condition. It usually begins during the period of convalescence from the primary infection but may occur earlier or later. Pain, tenderness, and limitation of motion are the clinical signs, with subsequent rigidity and changes in curvature.

Roentgenologic examination of the spine is important in the diagnosis. Unfortunately, definite changes may not appear until the later stage. Absorption of the intervertebral disk with slight destructive changes in the body of the vertebra is considered to be an early sign while bone proliferation from the periosteum and bone deposition along the lateral spinal ligaments resulting in bony ankylosis of the adjacent vertebral bodies are late manifestations. Widening of the paravertebral shadow indicating abscess formation is rare but did occur in the case reported in this article. Paratyphoid A bacilli were grown from the abscess, probably because antibiotics were not available for treatment. The films were reported as showing no disease early in the illness; later there was evidence of vertebral destruction and abscess formation and finally of healing.

Four roentgenograms (poorly reproduced).

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Pelvic and Extrapelvic Osteopathy in Rheumatoid Spondylitis. A Clinical and Roentgenographic Study of Ninety Cases. C. Maynard Guest and Harold G. Jacobson. Am. J. Roentgenol. **65:** 760–768, May 1951.

A total of 90 patients with rheumatoid spondylitis were studied at the Bronx Veterans Administration Hospital. Only those cases with unequivocal findings were included; otherwise the cases were unselected.

In 49 of the patients adequate histories and physical examinations with reference to the bones of the pelvis were obtained. Eighty-six per cent of this number experienced tenderness in these bones at one time or another. Adequate histories and physical examinations with reference to the sternum and ribs were obtained in 37 and 36 patients respectively. Tenderness occurred at these sites in approximately 60 per cent.

The roentgenographic changes suggesting osteopathy were: (1) irregular defects having a punched-out appearance in the pelvic and extrapelvic osseous structures; (2) irregular zones of increased bone density; (3) fringing of the periphery of bone.

Of the 90 patients, 74.4 per cent were found to have abnormal roentgenographic changes in the pelvic bones. The extent of these changes paralleled the severity and extent of the spondylitis. The average duration of back symptoms in 52 patients who had radiographic evidence of osteopathy limited to the pelvic girdle was approximately eight years. None of the patients had back symptoms for less than one year.

Osteopathy in areas other than the pelvic bones was observed in 18 of 90 patients. Fifteen of this group had radiographic evidence of disease in the pelvic girdle as well. The vertebral bodies were seen to be involved in 7 cases. The other bones implicated were: femur, humerus, scapula, carpal bones, sternal notch, elbow area, and the lower ends of the tibia and fibula. The toes and the patella were also seen to be involved. The average duration of back symptoms in this group of 18 cases was more than thirteen years, and all but one had paraspinal ligamentous calcification.

Of the 90 patients, 22.2 per cent had no abnormal changes in pelvic or extrapelvic osseous structures, although they showed the characteristic changes of rheumatoid spondylitis in the sacroiliac and apophyseal joints. The average duration of back symptoms in this group was five years.

Arthritis of peripheral joints, excluding the hips, temporomandibular joints and shoulders, occurred in 56.6 per cent of 83 patients who were adequately questioned and examined as to this point. There appeared to be no relationship, however, of pelvic and spinal osteopathy to peripheral arthritis. It is further concluded that the evidence in this study suggests that these changes are all inflammatory rather than adaptive in type, and that all of the changes described are similar to those seen in rheumatoid arthritis with or without spondylitis.

Nine roentgenograms; 6 tables.

I. MESCHAN, M.D.
University of Arkansas

Spondylolysis. Clinical-Radiological Study of 93 Cases. A. P. Lachapèle and Claude Lagarde, with the collaboration of R. Texier and J. Duluc. J. de radiol. et d'électrol. **32**: 453–464, 1951. (In French)

The authors present a study of 93 cases of spondylolysis which they have personally observed. Spondylolysis is defined as a solution of continuity of the posterior vertebral arch and more precisely of the interapophyseal isthmus. Anatomists estimate an incidence of about 4 per cent in man. If one does not constantly think of the diagnosis, however, the minimal defects will not be perceived in the roentgenogram. The authors found their first 10 cases in a series of 2,000 consecutive examinations of the lumbosacral spine, an incidence of 0.5 per cent. In each of these 10 cases the displacement was rather clear, usually more than 3 mm. With increased familiarity with the condition, 33 cases were discovered in the next 610 examinations, that is, 5.4 per cent.

In 86 cases, or 92 per cent of the total series, the lesion occurred at the level of the 5th lumbar vertebra. The condition was bilateral in 73 cases and unilateral in 13 cases. The majority of the patients were seen in the third, fourth, and fifth decades of life. A discussion of the radiologic features as seen in various projections is given.

Spondylolysis is believed to be a developmental defect, trauma playing a role in aggravating the condition or in bringing it to the attention of the roentgenologist.

Nineteen roentgenograms; 1 table.

CHARLES M. NICE, M.D.
University of Minnesota

Chondromalacic Spondylosis. E. Günsel. Fortschr. a. d. Geb. d. Röntgenstrahlen **74**: 522–525, May 1951. (In German)

In three men suffering from endarteritis obliterans, acute osteochondrosis of the spine occurred after lumbar block of the sympathetic nerve by means of novocaine injections and persisted for about six months. A generalized chondromalacia of the disks appeared to be the primary lesion, with segmentary extension. The roentgen changes were typical and proceeded uniformly in all affected vertebrae. Chondromalacic spondylosis may represent a special localization of Winiwarter-Buerger's disease and is apparently due to sudden disturbance of the arterial circulation.

Two roentgenograms. ERNST A. SCHMIDT, M.D.
Denver, Colo.

Discontinuities in the Course of the First Ribs. H. J. Kipshoven. Fortschr. a. d. Geb. d. Röntgenstrahlen **74**: 555–561, May 1951. (In German)

Different causes have been considered in the etiology of discontinuities of the first rib: (1) fractures due to coughing, sneezing, or other muscular strain (2) primary bone diseases, especially osteoporosis, (3) phylogenetic factors, and (4) anomalies of calcification in combination with osseous variations of the cervicotruncal area. None of these explanations is completely satisfactory. In many of the reported cases there has been no clinical evidence of either a genuine fracture or of a "creeping fracture." The fact that in the frequent osteoporoses of the post-war period such "fractures" did not occur more often than in normal times militates against the assumption of osteopathy in general. On the other hand, abnormalities of ossification must be considered, especially since the upper aperture of the thorax is subject to great developmental variation. The discontinuities correspond in shape and adaptation to real articulations. Arthrotic marginal spurs indicate that these pseudo-arthroses may be used functionally. Therefore, we may be dealing with hemi-arthrosis as it is observed between the manubrium and the body of the sternum. The formation of hemi-arthrosis would be dependent on function, *i.e.* on respiration. The absence of complaints on the part of the patients also speaks against fracture or other pathologic lesions. The more frequent observation of these discontinuities in patients suffering from pulmonary disease may be incidental, as such patients are more often examined radiologically.

One roentgenogram. ERNST A. SCHMIDT, M.D.
Denver, Colo.

Arthrokatadysis (Otto Pelvis). Richard Scandalis, Ralph K. Ghormley and Malcolm B. Dockerty. Surgery **29**: 255–259, February 1951.

Otto pelvis may be defined as "an affection of the hip joint characterized anatomically by deepening of the acetabulum with mesial displacement of the inner wall." The condition has also been known as Chrobak pelvis, Coxarthrolisthesis-Becken, osteoarthritic protrusion of the acetabulum, intrapelvic protrusion of the acetabulum, and arthrokatadysis.

Fifty cases of this condition from the files of the Mayo Clinic were studied. Cases were divided into two categories: (1) 41 cases in which the condition was primary (of unknown etiology) and (2) 9 cases in which it was secondary (of known etiology). In the former group four grades of intrapelvic protrusion were distinguished, grade one being the least pronounced and grade four the most pronounced. The causative factors in the 9 secondary cases were as follows: fracture of the acetabulum, 5 cases; septic arthritis, 2 cases; rheumatoid arthritis, 1 case; metastatic hypernephroma, 1 case.

The cause of arthrokatadysis remains obscure, despite voluminous writings on the subject. Suggested etiologic processes most often mentioned in the literature are, in order of frequency, osteoarthritis deformans, tabes dorsalis, localized osteomalacia, inflammation, echinococcus disease, endocrine factors, congenital defects, trauma, and gonorrhea.

Five case reports are included, with 6 roentgenograms.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Pelvic Horns: A Congenital Hereditary Anomaly Within the Framework of a Malformation Syndrome. K. Böck. Fortschr. a. d. Geb. d. Röntgenstrahlen **74**: 543–549, May 1951. (In German)

Pelvic or iliac horns were first described in the American literature by Fong (Radiology **47**: 517, 1946), with an editorial note of a similar observation by Doub. The abnormality consists in bilateral exostoses extending posteriorly from the iliac bones. The localization does not coincide with the insertion of the gluteal muscles. Clinically, the iliac horns are not productive of symptoms.

The author reports a case in a nineteen-year-old female with associated anomalies, including hypoplasia of the patella and faulty development of the fingernails. The patient's mother and two sisters showed similar

anomalies and the grandmother was known to have had abnormalities of the nails.

Nine roentgenograms; 1 photograph; 1 chart.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Fissure Formation in the Navicular Bone as Post-Traumatic Pseudarthrosis. H. Gieseking. Fortschr. a. d. Geb. d. Röntgenstrahlen **74:** 596–597, May 1951. (In German)

Fissure formation in the navicular bone of the wrist may be due to congenital bipartition or to pseudarthrosis after fracture. While generally the differential diagnosis is easy, in view of the presence or absence of a history of injury, occasionally so-called "creeping fractures" or "fatigue fractures" are encountered without definite history or clear-cut symptoms. The author presents the case of a 29-year old laboror who showed bilateral fissure formation of the navicular bone, which was successfully treated by nail fixation. From the fact that union occurred after this treatment the author concludes that the pseudarthrosis was of the acquired traumatic type and not due to congenital bipartition.

Two roentgenograms. ERNST A. SCHMIDT, M.D.
Denver, Colo.

Synovioma, with Special Reference to the Clinical and Roentgenologic Aspects. DeForest E. Hale. Am. J. Roentgenol. **65:** 769–777, May 1951.

The author reports 17 cases of synovioma seen at the Massachusetts General Hospital. About 100 cases have been previously reported. Of the author's patients, 60 per cent were below the age of thirty years.

The chief physical sign was a non-tender, firm mass in or near a joint, usually freely movable. A preoperative diagnosis of malignant tumor was made in only half of the cases. The neoplasm tends to be encapsulated and because of the relative ease of removal by blunt dissection the serious prognosis was not always recognized even at operation.

The diagnosis is suggested when a soft-tissue mass in or near a joint is demonstrated roentgenographically, showing lobulation and containing fine, speckled calcific densities laid down in small rounded masses irregularly arranged. At a later stage pulmonary metastases are demonstrated. They were present in all of the 11 fatal cases of the author's series. In 3 of the cases bone metastases remote from the site of primary tumor were found. Bony metastases appeared to be of hematogenous spread and were osteolytic in type, one of the cases showing concomitant osteoblastic lesions in the lumbar spine.

In those cases in which a mass is not in close proximity to a joint and in which no calcification is present, a roentgen diagnosis of synovioma depends very much upon chance. Such a mass may be differentiated from a lipoma in that the latter will cast a shadow of less density than adjacent tissue, whereas the shadow of a synovioma is of the same density as connective tissue or muscle.

The prognosis of synovioma is more grave than the name implies. Both the name, the slow growth, and the frequent encapsulation of the tumor are misleading to one unaware of the course of the disease. Among 104 cases reported by Haagensen and Stout (Ann. Surg. **120:** 826, 1944) only 3 five-year survivals were found. The location of the synovioma has a bearing on the prognosis in that those lesions located in an extremity are easier to remove surgically. Those patients who have done best in the author's series have had encapsulated tumors. The majority of synoviomas are slow-growing until the capsule is broken either spontaneously or at operation. Of 10 patients of the author's series whose tumors were excised locally, 9 are dead. It would seem that radical excision should be attempted in all cases and amputation reserved for local recurrence. Radiation therapy was of value in only 1 of 9 cases in which it was given.

Nine roentgenograms; 1 table.

WENDELL WARD, M.D.
University of Arkansas

Pigmented Villonodular Synovitis. Report of Seven Cases. Sid John Shafer and William A. Larmon. Surg., Gynec. & Obst. **92:** 574–580, May 1951.

Pigmented villonodular synovitis, bursitis, or tenosynovitis is thought to be inflammatory in origin, although a specific agent has not been determined. Some authors describe it as a true tumor, as indicated by the designations xanthoma, giant-cell tumor, and polymorphous-cell tumor.

The involvement of the synovia may be circumscribed or diffuse. In the circumscribed form, one or more firm, yellow-brown sessile or stalked nodular growths are seen. In the diffuse form the synovial membrane is usually reddish-brown, with scattered areas of yellowish-brown pigment. The villi are long and thin, and tend to intermingle. An occasional firm rounded nodule can be noted. The tendon sheath lesions bear a resemblance to the localized stalk lesions seen in the synovial membranes.

Lewis (Radiology **49:** 26, 1947) described the x-ray appearance of the lesion as it occurs in the knee joint, giving the following characteristics: "bones of a young adult; monarticular involvement; excessive amount of synovitis, which may appear smooth in outline and homogeneous in density, but is particularly diagnostic when it is, in part at least, nodular in outline and density, as is frequently the case; joint spacing symmetrical and normal, giving no indication of cartilage abnormality; completely normal appearing bones without even osteoporosis; no evidence of thigh or leg atrophy." It was further pointed out by Lewis that synovial sarcoma must be kept in mind when one of the following roentgenographic features is present: (1) a nodular soft-tissue mass or masses in part or wholly outside the joint capsule; (2) scattered and irregular deposits of amorphous lime within the soft-tissue masses; (3) invasion of bone by the soft-tissue masses.

Seven cases of pigmented villonodular synovitis occurring in various sites, as the knee, finger, and ankle, are reported here. All patients were young adults, and all had a history of joint swelling of from one to several years duration, without a history of definite trauma. In the knee cases physical examination showed no evidence of abnormality other than the swelling.

Incomplete excision of these tumors is invariably followed by recurrence. When complete excision is possible, postoperative x-ray therapy may not be necessary. When the excision is incomplete, supplementary irradiation is indicated, for the lesion is radiosensitive. In one of the cases presented, x-ray therapy was given, 1,814 r to the anterior and posterior compartments of the knee in divided doses, over a period of

twelve days, and there had been no recurrence after four years. In another case, in which 1,810 r were given at a 2 cm. depth to the popliteal space in divided doses over ten days, there was no clinical sign of recurrence in a year and a half.

Erosion of the adjacent bone and articular structure may occur, so that early excision is advisable.

Six roentgenograms; 9 photographs and photomicrographs.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

GYNECOLOGY AND OBSTETRICS

Hysterosalpingography with a Water-Soluble Medium in the Investigation of Infertility. Mary Pollock and Ella Preiskel. J. Obst. & Gynaec. Brit. Emp. **58:** 421–426, June 1951.

From May 1949 to September 1950, hysterosalpingography was carried out in 310 patients attending the Fertility Department of the Royal Free Hospital, London. The contrast medium was 35 per cent diodone made up in water (pyeosil). This medium is rapidly and completely absorbed from the peritoneal cavity and excreted by the kidneys. The danger of pulmonary oil embolism following intravasation is obviated; if intravasation does occur it is harmless. Using a rapid technic, a considerably more detailed study of tubal structure and tone can be obtained than with lipiodol.

The examination was diagnostic in 274 cases (88 per cent). In 15 (5 per cent) the findings were inconclusive because of cornual spasm, extravasation, or the inability to demonstrate peritoneal spill convincingly. Failure occurred in 11 cases (3 per cent), owing to the impossibility of passing the cannula through a spastic internal os. One hundred and seven of the salpingograms were normal; some abnormality was seen in 167 cases. Fimbrial occlusion with hydrosalpinx occurred in 41 cases (15 per cent) and was particularly well demonstrated with the aqueous medium.

Ampullary dilatation, indicative of tubal atony, was seen in 25 cases. This condition cannot be demonstrated with lipiodol salpingography or by insufflation.

The main disadvantage of diodone is its irritating effect on the pelvic peritoneum, which is greater than that of lipiodol. Transient slight pain in the lower abdomen or back was experienced by about 20 per cent of the patients; this reaction is usually associated with peritoneal spill and is often proportional to the amount of fluid injected. Only 3 patients complained of severe pain. Some patients experienced a feeling of faintness on rising from the couch, 2 actually fainted. Iodism with an acute urticarial reaction was encountered once, and a second time in a much milder form. A few patients felt unwell the day following the examination and others had some pelvic discomfort.

The technic of hysterosalpingography employed by the authors is described.

Four roentgenograms; 1 insufflation kymograph; 1 table.

Roentgenologic Demonstration of the Female Genital Apparatus with the Aid of Jodöl and Jodsol. J. Erbslöh. Ergänzungsband 58, Fortschr. a. d. Geb. d. Röntgenstrahlen, 1951.

This monograph on the contrast examination of the female genital tract is divided into three parts. In the first the author describes his investigations of the physical and chemical properties of the iodized oils and their practical application and points out the fundamental changes in physical and chemical qualities which take place when iodized oils are transformed into iodized colloidal solutions. In all the iodized oils examined, the viscosity was found to decrease with rising temperature. The viscosity of the colloidal solution, however, changed only slightly with temperature variations. With transformation into a colloidal sol, the iodized oil lost all the properties of an oily non-water-soluble material. Mention is made, also, of the fact that the specific weight and viscosity may differ in iodized oils of the same name when these originate from different manufacturers or when they are kept too long in storage.

In Part II, the properties of the ideal contrast medium are outlined. (1) It should be safe and should not irritate the mucosa. (2) It must moisten the mucosa. (3) It must have a low viscosity, as preparations with high viscosity demand a high filling pressure, expanding the uterine cavity and subjecting it to harmful pressures, thus making tubal filling more difficult. (4) The preparation should not be too opaque so that, after the injection, one should be able to see the irregularity of the internal structures of the uterus. (5) The surface tension should be low.

Preparations used in hysterosalpingography include those soluble in oil and those soluble in water. The oil-soluble preparations are less irritating and less dangerous. Their disadvantages are high viscosity, imperfect extension, and the dense silhouette which they produce. Water-soluble preparations have a low viscosity and a better ability to moisten the surface, but on account of their hypertonic properties they irritate the membranes.

The ideal preparation for contrast is one which offers the advantages of both oil-soluble and water-soluble types without the disadvantages of either. Iodized colloidal solution was found to meet these requirements. It is water-soluble, has the same osmotic pressure (isotonic) as blood, is of low viscosity, and does not cause oil emboli. A particle of this sol is 300 times smaller than the erythrocyte. Its absorption from the peritoneal cavity is very rapid.

In the final section of his monograph the author shows how much depends on the physical and chemical properties of the medium and in what manner the different preparations influence the radiological effects. Numerous cases are reported in which fetography and hysterosalpingography were carried with different media. In no instance did intra-amnionic injection cause any injury to the mother or fetus.

The best contrast medium for fetography proved to be Immetal, an esterated iodized oil manufactured in Germany (Bayer). This was found to spread over the fetal surface and form a film without regard to the presence or absence of amnionic fluid. Prior to this it was assumed that an intra-uterine opaque medium would appear in the fetal pulmonary system, but this was proved not to be the case. This cannot be taken, however, as evidence against intrauterine respiratory activity but indicates rather that the contrast medium was not able to moisten and adhere to the bronchial tree. It was further found that a fetogram cannot be obtained in the early months of pregnancy, because at this stage the fetal surface is not covered with vernix caseosa; it has instead a more serous character and therefore the contrast oil is not able to moisten the surface. Colloidal iodized oil solutions proved unsatisfactory for fetography.

Hysterosalpingography with iodized oils of different viscosity demonstrated that those with high viscosity produce slow filling of the uterus and then filling of the fallopian tubes, while the low-viscosity oils fill both the uterus and the tubes rapidly and easily. Films must be taken during fractional injection, since those following completion of the procedure show only an empty uterus and partially empty tubes.

Indications for the employment of high- and low-viscosity iodized oils are, respectively, to outline the contours of the uterine cavity and to demonstrate tubal narrowing, whether pathological or due to compression. For high-viscosity oils 200 mm. Hg pressure was sufficient; for oils of low viscosity only 66 mm. Hg pressure was required.

A case in which a normal uterus was filled with 1.75 c.c. of colloidal iodized oil illustrates the advantages of that medium: No fluoroscopy is necessary; only one film is required to make a diagnosis; a small dose of the medium is sufficient, and resorption is rapid.

The author foresees a great future for colloidal iodized oil solution as a contrast medium and predicts that the need for exploratory surgery for uterine and tubal disease will be lessened by the more adequate diagnostic work-up now feasible with this medium. He demonstrates with this "sol" polyps, adenomas, myomas, and corpus carcinomas.

Sixty-four illustrations, including 13 fetograms and 26 hysterosalpingograms. ILONA D. SCOTT, M.D.
VA Hospital, Chamblee, Ga.

The Diagonal Conjugate. D. Frank Kaltreider. Am. J. Obst. & Gynec. **61**: 1075–1086, May 1951.

This study of the diagonal conjugate is based on roentgen pelvimetric examinations performed on 1,133 patients, 542 white and 591 Negro. Smellie's rule that the clinical diagonal conjugate is 1.5 to 2.0 cm. longer than the true conjugate was found to be inaccurate and rather dangerous to use in cases of inlet contraction. It was also found that clinical evaluation of the diagonal conjugate is grossly inaccurate, whether performed by relatively inexperienced (resident staff) men or by experienced (staff) men.

It was shown that vaginal delivery can be expected in most instances when the clinical diagonal conjugate is above 11.5 cm. However, a clinical diagonal conjugate of over 11.5 cm. should not be interpreted as assuring no pelvic difficulty at the inlet in any individual case.

The author concludes that roentgen pelvimetry is obviously the more accurate method of determining the diagonal and obstetrical conjugates in all cases and only routine pelvimetry can demonstrate "all suspect pelves." He cautions against elective interruption of pregnancy on the basis of roentgen interpretation alone, except in abnormal presentations. Roentgen pelvimetry is only one factor in the clinical prognosis of labor.

Nine figures; 8 tables.
T. FREDERICK WEILAND, M.D.
Jefferson Medical College

"The Flying Foetus." A Case of Hyperextended Attitude Encountered in a Transverse Presentation. Frank Denny. J. Obst. & Gynaec. Brit. Emp. **58**: 427–429, June 1951.

A case of transverse presentation with hyperextension of the fetus is reported, and the possible etiology of the condition is discussed. Roentgenograms taken to exclude a multiple pregnancy showed the fetus lying transversely, with hyperextension of the back, in "flying" position. Post-delivery hysterosalpingograms revealed most strikingly the features of a *uterus bicornis unicorpus unicollis*. The mother states that at seven months of age the infant still had a tendency in certain positions to "throw its head right back."

Three roentgenograms; 3 photographs.

THE GENITO-URINARY SYSTEM

Thorotrast in the Kidney Eleven Years After Pyelography. K. Breckoff. Fortschr. a. d. Geb. d. Röntgenstrahlen **74**: 594–595, May 1951. (In German)

In a 65-year-old woman radiopaque ramified and stellate shadows were noted in the kidney parenchyma in the region of the cortex and the outer medullary layer. These shadows had the density of calcification but were proved to be residual to a retrograde pyelographic examination eleven years previously, with thorotrast as the contrast medium.

The possible later dangers of thorotrast retention in the human system are discussed. Reference is made to MacMahon and collaborators, who described a reticulosarcoma of the liver after thorotrast injection (Am. J. Path. **23**: 585, 1947. Abst. in Radiology **50**: 724, 1948), as well as to Zollinger, who described a spindle-cell sarcoma of the kidney sixteen years after thorotrast pyelography (Schweiz. med. Wchnschr. **79**: 1266, 1949. Abst. in Radiology **55**: 790, 1950). From the fact that this type of tumor rarely occurs spontaneously in the kidney but frequently results from thorotrast injections in animal experiments, it is concluded that the radioactivity of thorotrast is responsible for its development. The operative removal of a kidney retaining thorotrast over an extended period of time may therefore be justified. At least, regular follow-up examinations of the patient appear indicated.

A study of the roentgenograms in the present case shows that the presence of the thorotrast in the renal parenchyma was due not to simple "reflux" but to "efflux" (according to Günther: Ztschr. f. Urol. **42**: 42, 1949), *i.e.* passage into the parenchyma either through preformed fissures or through minimal tissue ruptures caused by increased filling pressure.

Two roentgenograms. ERNST A. SCHMIDT, M.D.
Denver, Colo.

Congenital Cystic Dilatation of the Renal Tubules. A New Disease Entity. Vincent Vermooten. Yale J. Biol. & Med. **23**: 450–453, June 1951.

The author reports an example of what he believes to be a new disease entity, consisting of a gross cystic dilatation of the collecting tubules of the kidney and characterized by gross painless hematuria. In the urogram the dilated tubules gave the appearance of a bunch of grapes attached to each minor calyx. No similar cases were found in the literature, but in an appended footnote a personal communication from Dr. Wyland Leadbetter is cited mentioning 5 cases seen over a period of twelve years and referring to a case in the French literature (Cacchi and Ricci: J. urol., Paris **55**: 497, 1949).

After observing his case, the author reviewed 464 excretion urograms, and found that in 35 instances the collecting tubules were demonstrated—in some merely as a faint fan-like area of density, in others as a beading

along lines radiating out from the calyx, and in the remainder as obvious areas of radiopacity such as were seen in the case reported His theory is that this congenital dilatation of the tubules is the end-result of damage due to the deposition of uric acid crystals in the tubules during intrauterine life. "Caliceal diverticula" appear to be localized lesions of this type, while "nephrocalcinosis" is actually multiple calculi which have formed in the dilated tubules, irrespective of the cause of the hypercalcinuria.

Fifteen roentgenograms; 2 photographs.

JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

Calcinosis of the Kidneys Associated with Parathyroid Tumor: A Clinical and Pathological Study with Case Report. Jack D. Kirschbaum and Hal T. Wilson. Urol. & Cutan. Rev. **55:** 264–268, May 1951.

The case of a 61-year-old woman with nephrolithiasis and parenchymatous calcinosis associated with a benign adenoma of the parathyroid gland is reported. The mechanism of the mobilization of calcium from the bones by the excessive amounts of parathyroid hormone is discussed.

The authors point out that early in hyperparathyroidism neither bone rarefaction nor the presence of hypercalcuria are specific enough to make the diagnosis, and laboratory studies of the serum are necessary. Furthermore, the diagnosis could be made much earlier if the condition was considered in cases of known renal calculi, generalized demineralizing bone disease, or in the presence of unexplained polyuria, polydipsia, or somnolence.

Two roentgenograms; 5 photographs.

FRANK T. MORAN, M.D.
Lancaster, Pa.

Renal Calculi. Etiology and Differential Diagnosis. Vincent Vermooten. Texas State M. J. **47:** 96–100, February 1951.

On the whole, the diagnosis of renal calculi is no longer difficult, but a better understanding of their etiology and the causes of recurrence has made the urologist more cautious and has tended to make his surgery more conservative. It becomes increasingly important therefore to make a radiological diagnosis of the various types with differentiation between metabolic stones (cystine, xanthine, uric acid), alkaline earth stones, and oxalate stones. As a rule, metabolic calculi are relatively translucent but frequently they may contain just enough calcium to render them opaque. Radiologically they show a homogeneous density and at times they can be recognized by this characteristic. Not infrequently they are multiple and faceted. If these observations can be made, metabolic and other studies are indicated.

In contrast to the metabolic form of stone, the lamellated calculus is always one of the alkaline earth stones and consists, as a rule, primarily of calcium phosphate, although frequently ammonium phosphate and carbonate, as well as calcium carbonate, are present. This form of calculus is usually seen in an alkaline urine which may result from infection caused by a urea-splitting organism. If a urea-splitting organism is at fault, the calculus should not be removed unless the infection cannot be controlled. Otherwise, the calculus will recur. In the absence of such an organism, the urine must be acidified postoperatively and the acidity maintained or there will be a prompt recurrence. It should also be proved that the patient does not have hyperparathyroidism before surgery is advised.

Calculi growing like a snowflake with branching crystals stemming from a central core are composed primarily of calcium oxalate. If the calculus is slow-growing, there is no need for concern. On the other hand, if it grows rapidly, great care must be exercised in removing all the small fine, soft crystals which cover the surface. Otherwise, there is left a nidus upon which more calculi may form.

All patients with multiple renal calcifications should be checked for hyperparathyroidism. In a recent series of 83 cases of hyperparathyroidism, 27 per cent of the patients had caliceal, pelvic, and ureteral calculi; 23 per cent had tubular calculi, and the others had a general salt deposition in multiple organs of the body, including the renal papillae.

Three case reports; 8 roentgenograms; 3 photomicrographs.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Sjogren's Disease Associated With a Pulmonary Lesion and Nephrocalcinosis. Maurice Nellen. South African M. J. **25:** 401–404, 427–430, June 16 and 23, 1951.

This is a case report of a rare disease characterized by chronic swelling and fibrosis of the salivary and lacrimal glands with associated dryness of conjunctivae, mucous membranes of the mouth, and the upper respiratory tract. This is the second reported case with an associated lung lesion, in this instance bronchopneumonic in type and considered to be due to lack of secretion by bronchial mucous glands. The patient also had chronic pyelonephritis due to *B. coli* and *Ps. pyocyaneus*, with nephrocalcinosis in the region of the calices.

An excellent discussion of pathogenesis of nephrocalcinosis is included. The term may be used to describe several different conditions of widely different etiologies, characterized by calcium deposits in the renal parenchyma, found in the pyramids alone, or in the cortex, or in both. It has not been suggested for those cases with calcification at the tips of the calices, as in the author's patient.

As to the causes of nephrocalcinosis, the author quotes Goldstein and Abeshouse (Radiology **30:** 544, 667, 1938) who recognized three types: In *Type 1* there is an increase of calcium salts of the blood, due to absorption from bone lesions. The majority of these cases develop in the absence of a renal lesion. In *Type 2* there is a renal lesion, which may be primary, *i.e.* acute or chronic nephritis, or secondary (so-called), due to a toxic nephrosis. Hypercalcemia is not essential for this type of renal calcification, but the calcification is more marked in those cases with transitory or permanent increase in blood calcium. In *Type 3*, there is a renal lesion, inflammatory, traumatic, obstructive, or neoplastic. Hypercalcemia plays no role in this type.

Calcification of the renal parenchyma in primary hyperparathyroidism is associated with hypercalcemia, while in renal insufficiency the blood calcium level is slightly subnormal. When there is phosphate retention due to renal insufficiency, hyperparathyroidism may be associated with a normal serum calcium level. Nephrocalcinosis associated with persistent rickets and with hyperchloremic acidosis is mentioned and discussed.

Four roentgenograms.

I. R. BERGER, M.D.
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Some Observations on Renal Tuberculosis in Newfoundland. H. B. Murphy. J. Canad. Assoc. Radiologists **2**: 33–36, June 1951.

Newfoundland has a high incidence of all forms of tuberculosis, and renal tuberculosis is no exception, 81 cases having been seen over a period of three years, 71 of these among a population of 150,000. Thirty-one patients had bilateral disease and the majority had advanced lesions, yet renal tuberculosis did not cause any death in the period reviewed.

The papilla is usually the primary site of renal involvement, with gradual excavation of the kidney substance locally, followed by spread to other calices, the pelvis, ureter, and bladder. On pyelograms in the early stages the involved calices are distorted and ragged, but as fibrosis develops, the calices become constricted and finally closed off. Massive infection may lead to extensive calcification or so-called "autonephrectomy."

Surgical removal is the standard treatment but antibiotic therapy with streptomycin and PAS is becoming important. The author believes that fibrosis is more severe and rapid following streptomycin. Careful periodic observation for hydronephrosis is advised, especially in patients with one kidney removed.

Eleven roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Roentgen Appearance of a Paranephric Abscess Perforating into the Duodenum. Pierre Eggimann. Radiol. clin. **20**: 145–147, May 1951. (In German)

A 21-year-old male had suffered from fever, abdominal cramps, occasional diarrhea, and vomiting for three weeks and pain in the right kidney region for two weeks. He had lost 20 kg. since the onset of his illness. The laboratory findings, including urine examinations, were negative except for a moderate anemia and a sedimentation rate of 38/80.

A scout film of the abdomen with the patient standing showed several air-fluid levels in the small and large intestines. An irregularly shaped area of radiolucency superimposed upon T-11 and T-12 was also seen. The intravenous pyelogram was normal except for a diminished respiratory mobility of the right kidney. An oral barium study showed escape of contrast material from the posterior aspect of the duodenum into a biloculated cavity surrounding the kidney. This cavity emptied with the patient in the prone position, permitting a "double-contrast" view of its walls.

A roentgen diagnosis of paranephric abscess with perforation into the duodenum was made. Whether or not an operation was performed is not stated. No autopsy is reported.

[The possibility of a duodenal ulcer perforating into the paranephric space appears just as likely an interpretation—G.S.S.]

Four roentgenograms.

GERHART S. SCHWARZ, M.D.
New York, N. Y.

Pyelographic Deformity Produced by a Hepatic Abscess. William M. Coppridge, Louis C. Roberts, and David A. Culp. J. A. M. A. **146**: 107, May 12, 1951.

Filling defects in pyelograms are produced most frequently by renal tumors that arise from either the parenchyma or pelvis. It is not uncommon, however, for cysts, tuberculosis, calculi, abscesses, blood clots, and air bubbles to produce filling defects simulating neoplasm. Extrarenal diseases may produce a similar picture. Perinephric abscesses, lipomas, retroperitoneal neoplasms, and pancreatic cysts have been reported as causing pyelographic deformities. The authors report a case of hepatic abscess producing a filling defect on the pyelogram.

The patient was admitted because of right upper quadrant pain, fever, and malaise. The provisional diagnosis was pneumonitis although physical examination was essentially negative. The chest film was normal and a urologic consultation was advised because of the septic course in spite of antibiotics. A filling defect was noted on retrograde pyelography and a preoperative diagnosis of renal abscess or perinephric abscess was made. Subsequent operation revealed the hepatic abscess. Drainage was followed by uneventful recovery.

One roentgenogram. O. W. DOYLE, M.D.
University of Michigan

THE BLOOD VESSELS

Aneurysm of the Pulmonary Artery. M. G. Israels. Canad. M. A. J. **64**: 433–435, May 1951.

True aneurysm of the pulmonary artery is of rare occurrence. Deterling and Clagett (Am. Heart J. **34**: 471, 1947) stated that from 1785 to 1946 only 6 aneurysms of the pulmonary artery were found among 4,126 aneurysms of various types in the thorax.

The author presents a case involving the trunk and two main branches of the pulmonary artery. It is the first case recorded in Regina, Sask., in a period covering fifteen years and 2,462 autopsies. The radiographic findings of this condition include marked bulging of the pulmonary shadow and right-sided cardiac enlargement. In the right anterior oblique view the aneurysmal shadow encroaches on the retrosternal space when the right main branch is involved. A sharply defined hilar pattern, particularly on the right, is a valuable radiographic sign. A hilar dance may be demonstrable fluoroscopically.

Three roentgenograms. J. M. KOHL, M.D.
Jefferson Medical College

Subclavius and Anterior Scalene Muscle Compression as a Cause of Intermittent Obstruction of the Subclavian Vein. Robert S. McCleery, John E. Kesterson, James A. Kirtley, and Ross B. Love. Ann. Surg. **133**: 588–601, May 1951.

Five cases of intermittent obstruction of the subclavian vein are presented along with an operative technic which affords complete visualization of the three portions of the subclavian vein. The authors feel that venograms are of real value in establishing the diagnosis and locating the site of the affecting mechanism. The venographic technic is as follows: After preliminary testing for sensitivity to diodrast, the patient is placed in a supine position with the arm at the side and with a tourniquet on the upper arm. Thirty c.c. of 70 per cent diodrast are then injected as rapidly as possible into an antecubital vein through an 18-gauge needle. Eight seconds after the injection is begun, the film is exposed. A 14 × 17-inch film is used and the roentgen-ray tube is centered over the medial third of the clavicle. The procedure is repeated with the arm abducted 90 degrees, as an additional 30 c.c. of the medium are injected. Normal and abnormal venograms are reproduced and postoperative comparison venograms are also shown.

Complete obstruction was suspected on the basis of the venograms in one case, but was not found at operation. All cases showed marked improvement following division of the anterior scalene muscle and excision of the subclavian muscle.

Six venograms; 15 drawings; 2 tables.

J. DUDLEY KING, M.D.
Crawford W. Long Hospital
Atlanta, Ga.

Some Points in the Management of Varicose Veins. C. H. Wickham Lawes. M. J. Australia **1**: 637–644, May 5, 1951.

Retrograde injection treatment of varicose veins has been called dangerous on the basis of phlebographic evidence showing the dye entering the communicating and deep veins in quantity after injection into a superficial vein. However, the author points out that in phlebography a much larger quantity of medium is used and under more pressure than should be used for the sclerosing solutions. This is in keeping with the general knowledge that deep vein thrombosis and subsequent pulmonary embolism are rarely seen after varicose vein injections.

It is believed that more care should be taken to diagnose the extent of the condition by means of the various clinical tests before operation is planned. Recurrences are due to faulty technic—usually from overlooking some small tributary which subsequently enlarges, or failure to diagnose and ligate an incompetent communicating vein ("blow-out").

Four roentgenograms; 11 drawings.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

TECHNIC; CONTRAST MEDIA

Demonstration of the Atlanto-Epistropheal Joints and the Transverse Processes of the Atlas and Second Cervical Vertebra. C. Buetti. Radiol. clin. **20**: 168–173, May 1951. (In German)

The author takes anteroposterior oblique views through the open mouth for the roentgen demonstration of the atlas and neighboring structures in addition to a regular anteroposterior open-mouth view. One normal and two abnormal cases are presented.

To obtain these views, the patient is placed in supine position on the Bucky table, his head rotated 40 to 45° to the side. His neck is flexed as far as the chin of the open mouth will permit. The central beam should emerge through the tip of that mastoid process which lies closer to the film and should be directed perpendicularly to the table.

Six roentgenograms.

GERHART S. SCHWARZ, M.D.
New York, N. Y.

Pneumoretroperitoneum. Lucio Rossi. Ann. radiol. diag. **23**: 340–394, 1951. (In Italian)

The author reports on his experience with the retroperitoneal injection of gas and states that this technic is useful to study the contours of the kidneys, to visualize the liver, and spleen, to study tumors of the right colon, to differentiate retroperitoneal from intraperitoneal neoplasm, for the visualization of the pancreas, and for the study of tumors of the ovary and uterus.

The published radiographs and laminagraphs are excellent, but this abstractor cannot help wondering whether the same diagnostic results could not have been obtained in many cases without the use of this technic.

Forty-eight roentgenograms; 5 drawings.

CESARE GIANTURCO, M.D.
Urbana, Ill.

Equipment for Microradiography with Soft Roentgen Rays. A. Engström and L. Wegstedt. Acta radiol. **35**: 345–355, May-June 1951.

Microradiography has proved useful in the study of biological materials, particularly bone and dentine tissues. This paper describes in detail, with the help of formulae and drawings, the construction of microradiographic equipment for both qualitative and quantitative microradiography of dense biological tissues, using a commercial sealed-off roentgen tube.

The principle is as follows: The specimen to be examined is placed in good contact with a very fine-grained photographic emulsion and by the use of soft roentgen rays a contact image of the sample is produced. This small roentgen image is then enlarged by photomicrography. For the roentgen ray source a Machlett A.E.G. 50 sealed-off roentgen tube with a beryllium window is used.

Cell weight and structures can be determined by microradiography. Macro- and microscale determinations are done by a photometer.

The equipment described in this paper has been successfully used for microradiography of bone tissue and other structures with a high content of calcium salts, soft tissues with a high content of dry substance (outer layer of skin), and microtome sections of soft tissues which have been impregnated with salts of heavy metals.

Twelve illustrations, including 4 microradiograms.

W. H. SOMERS, M.D.
Indiana University

Effects of Ioduron B on the Respiratory Tree of Guinea Pigs. N. M. Brown, L. A. Caswell, A. Miller, and W. H. Mathews. J. Canad. Assoc. Radiologists **2**: 24–27, June 1951.

Ioduron B is a water-soluble iodine-containing organic compound of high viscosity recently recommended for bronchography. The authors obtained good bronchograms with this medium in 5 cases but in every instance the procedure led to hemoptysis. A study was therefore made on guinea-pigs, both with ioduron B and with lipiodol, to obtain microscopic evidence of the effect of the medium on the respiratory tree. Some animals were sacrificed immediately following bronchography and others twenty-four hours later.

The animals receiving lipiodol showed no evidence of any immediate reaction and only slight hyperemia and spasm in twenty-four hours. There was no desquamation. The ioduron B animals, on the other hand, showed congestion of the vessels underlying the trachea, mucosa, bronchial spasm, sloughing of the bronchial mucous membrane, and small areas of atelectasis as immediate reactions, with further changes after twenty-four hours, to the point of necrosis of epithelial cells in the trachea, desquamation of bronchiolar mucous membranes, and blood in the bronchioles.

It would appear from this study that ioduron B is far from an ideal medium for bronchography.

Two roentgenograms; 4 photomicrographs.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

MISCELLANEOUS

Organ-Displacing Abdominal Tumors. John J. Morton. Ann. Surg. **133:** 665–683, May 1951.

The author in this fairly detailed paper gives an excellent review of the more commonly encountered abdominal tumors. He describes the pattern of organ displacement and explains the reason for the displacement on an anatomical basis. He divides the abdominal cavity into three compartments: an upper compartment, middle compartment, and lower compartment. These have rather natural boundaries. The upper and middle compartments are divided into right and left halves by the spine. Lesions are grouped in such a fashion as to aid one in making an intelligent differential diagnosis. Twenty-two illustrative cases are reported.

This article will be found to be an excellent review for radiologists.

Two roentgenograms; 7 drawings.

JOHN DUDLEY KING, M.D.
Crawford W. Long Hospital
Atlanta, Ga.

RADIOTHERAPY

Supervoltage Radiotherapy. B. W. Windeyer. J. Faculty Radiologists **2:** 285–292, April 1951.

By common usage the term supervoltage x-ray therapy now usually indicates treatment with x-rays generated at a minimum potential of a million volts. The author makes an arbitrary division between x-rays generated in the one to four million volt range and those generated at much higher voltages. Only in the one to four million volt range is there adequate clinical experience; therapeutic application is practicable, and adequate physical and biologic data are available.

Comparative isodose curves for beams of x-rays generated at four million volts, one million volts, and 200 kv. illustrate that with an increase in potential there is an increase in percentage depth dose and exit dose and a decrease in the lateral scatter. Interpreted from the clinical standpoint this means less skin damage for a given tumor dose as the potential is increased and, more important, considerable decrease in total body dose or integral dose with supervoltage radiation as compared with conventional 200 to 250-kv. therapy.

Another advantage of supervoltage x-rays not shown in isodose curves is that a marked preferential energy absorption in bone does not occur as with 200 to 250 kv. This is important in that bone becomes a less serious factor in reducing the dose delivered to a tumor partly enclosed by bony structures. Also, there will be less likelihood of bone necrosis.

Clinical evidence of value of x-rays in the one to four million volt range is difficult to assess. Increased depth dose and altered distribution of radiation may lead to severe damage to tissues deep to the body surface and the skin reaction is no longer a clinical guide. However, several writers have shown an improvement in the curative results in certain deep-seated lesions with supervoltage irradiation. This opinion is probably best illustrated in a quotation from Cantril and Buschke (Radiology **53:** 313, 1949) who said, "For a small group of malignant tumors, not exceeding 10 per cent of all cancers to be treated, supervoltage irradiation may be a decisive factor in curability."

The usefulness of the supervoltage generators is not limited to deep-seated lesions. Relatively superficial lesions of the head and neck may be greatly benefited because a smaller volume of normal tissue can be irradiated. This means considerably less discomfort to the patient.

The author discusses certain characteristics of high-voltage generators and concludes that there is a definite need for such an apparatus in large radiotherapy departments. He stresses that such equipment is not a substitute for 200 to 250-kv. machines but rather that it should be considered as necessary to fill a gap in our present armamentarium.

Four illustrations.

RICHARD A. ELMER, M.D.
Emory University

Supervoltage Technique and Engineering. Odd Dahl. J. Faculty Radiologists **2:** 293–301, April 1951.

Since March 1942, the 1,500-kv. electrostatic x-ray generator at the Haukeland Municipal Hospital in Bergen, Norway, has been in continuous service for deep-therapy work. This generator is operated at atmospheric pressure and will deliver an x-ray output of 135 r per minute per ma. at 70 cm. skin-target distance through 10.5 mm. lead equivalent filtration. The experiences with this generator are summarized and its technical features are described.

The over-all performance of this type of installation is evaluated in comparison with other types, and the factors influencing choice of operating voltage are discussed, together with service problems.

Large shock doses of very hard x-rays or very fast electrons are in these days produced in the laboratories, principally for the use of biochemists in studies of biochemical effects of radiation in dead tissue. Equipment especially designed to give a large quantity of radiation in very short time pulses is mentioned, and the possible application to the medical field is pointed out.

In conclusion the possibilities and limitations of the electromagnetic induction type of electron accelerator—the betatron—are mentioned, and a brief reference is made to recent British work in connection with linear accelerators as x-ray generators.

Eight illustrations.

RICHARD A. ELMER, M.D.
Emory University

Some Experiences in Management of Cancer of Middle Ear and Mastoid. Walter L. Mattick and John W. Mattick. Arch. Otolaryng. **53:** 610–621, June 1951.

In general, tumors of the ear are classified as (1) extrinsic—those occurring on the auricle, concha, or external canal; (2) intrinsic—those occurring in the tympanic cavity, tympanic membrane, or mastoid; (3) indeterminate—those for which it is impossible, owing to the advanced stage of the lesion, to ascribe an origin in either of the two former regions. Of the 10 cases reported by the authors, all proved by microscopic section and/or autopsy, 8 were presumably of intrinsic origin and 2 of indeterminate origin. Extrinsic lesions, while much more numerous, are not considered here.

Diagnosis was most quickly arrived at in these cases through the history of hearing loss, otorrhea, pain, and

bleeding from the ear canal, from which a biopsy of presenting granular or polypoid tumor could generally be made. Roentgenograms of the mastoid and petrous bone were not as generally helpful in early diagnosis as might be expected. Their chief value seemed to be in recording the progress of the disease. The principal findings in the mastoid roentgenograms were reported as cloudiness and poor aeration on the affected side in 5, sclerosis in 4, poor cell outline in 3, and coalescence or destruction of bone structure in 1 of the patients.

Management consisted in (1) surgical ablation, *i.e.*, radical mastoidectomy with or without electrocoagulation, (2) radium application in the middle ear, mastoid and/or external canal, followed by (3) external high-voltage x-ray therapy to the affected ear and mastoid. One patient, moribund on admission, was not treated.

Following surgical ablation, intracavitary gamma irradiation was the method of choice until the surgical wound was nearly healed. This varied in these cases from 200 millicuries in 0.3 mm. of gold applied in the mastoid cavity in the first case to 540 milligram hours of radium in 0.6 mm. of platinum in the fifth case. In one patient, who steadfastly refused operation, a beta ray applicator was applied against the tumor in the external canal, with only temporary or slight regression. In one case a 4-gm. radium pack was used.

Three patients were treated later with 200 kv. x-rays and in 4 cases 400 kv. x-rays were applied to full skin tolerance. Electrocoagulation was used in conjunction with surgery in 2 cases.

Seven of the tumors were classified as squamous-cell carcinoma. Two of the patients in this group had remained well and free of the disease over five years. Two cases, more controversial, were reclassified as glomus jugulare tumor. One of these patients is apparently well and free of disease for over five years, and the other, refusing operation, has been comfortable for over eight years.

Four photomicrographs; 1 table.

Carcinoma of the Gum. Walter L. Mattick and Donald J. Meehan. Surgery **29**: 249–254, February 1951.

One hundred and one cases of carcinoma of the gum are reported. These were all squamous-cell carcinomas and were more or less evenly divided between the right and left sides and the upper and lower gum. The midline is a rather uncommon site, only 5 cases occurring in that location in this series. Since the gum is such a narrow structure, adjacent structures were invaded frequently. The lower gum lesions often involved the buccal mucosa and/or floor of the mouth. Carcinomas of the upper gum frequently extended to the buccal mucosa and/or the palate.

The majority of the patients complained of a sore on the gum, occasionally accompanied by pain or bleeding. Thirty per cent had metastatic lymph nodes present when admitted, and in approximately 50 per cent metastatic neck nodes developed during the course of the disease. Autopsies performed in 4 cases revealed distant metastases in the lungs, liver, and other viscera. There were no cases with distant metastases without evidence of cervical node involvement. There was only one case of cross-spread metastasis.

All cases in this series were treated solely with radiation. All forms of radiation were used, including radium, radon seeds, and x-rays. During the eight-year period covered, the method of treatment varied with radiologic advances. The oral lesions, when appropriate, were treated with the radium mouth mold with a calculated dose of 6,000 gamma r delivered to the surface of the lesion. This treatment lasted exactly two weeks and was followed by a supplementary course of external irradiation with a cheek or submaxillary port directed at the lesion. Metastatic nodes, when present, were either spotted with small ports or else included in the path of the supplementary port. External x-radiation was delivered for the most part with the 200-kv machine with 0.9 mm. Cu half-value layer. A number of patients had radon seeds implanted in the nodes along with the external radiation. Instead of the radium mold, intraoral roentgen irradiation was used in some cases.

The cure rate for the entire group was 19 per cent and for patients with lesions without bone or node involvement, regardless of size, 36 per cent. In 53 patients the disease was limited to the oral cavity without bone invasion. In this group there were 19 five-year survivals. There were no five-year survivals in the group with bone or node invasion.

The incidence of radiation osteomyelitis in the cured patients was 16 per cent. In 3 patients with radionecrosis of the bone the sequestrum was eventually extruded, and on last examination all showed the mucosa to be intact over the bone. No attempt is made to ascertain the incidence of osteomyelitis in the group that succumbed to the disease.

On the basis of this rather poor survival rate and the fact that no patients with node or bone involvement were cured, the authors are, at the present time, using the combined jaw and neck resection more and more frequently. They feel that, where there is bone involvement, surgery is definitely indicated. The treatment of patients with early gum carcinomas without node or bone involvement is still being evolved.

Three tables. ALFRED O. MILLER, M.D.
Louisville, Ky.

Roentgen Rotation Therapy in Cancer of the Hypopharynx. Inge Gynning. Acta radiol. **35**: 443–448, May-June 1951.

The author treated 5 patients with roentgen rotational therapy for cancer of the hypopharynx, utilizing rotation before a horizontal fixed roentgen tube and using a filter of 0.5 mm. copper plus 1.0 mm. aluminum, 165 kv., 53 cm. distance, and 0.85 mm. Cu h.v.l. In 2 cases there were local recurrences within one year after a depth dose of 4,500 r in fifteen to twenty-one days; 1 patient died of untoward radiation reaction and secondary bronchopneumonia five and one-half months after conclusion of treatment and a tumor dose of 5,200 r in twenty days with no evidence of residual cancer; and 2 patients were well seven years following treatment.

Both of the survivors had shown a pronounced Plummer-Vinson syndrome before therapy. Daily doses of 165 to 240 r were given for a total of 5,200 r in twenty-four days in each case. During the first month after treatment both patients found swallowing difficult and were aphonic. In another month hoarseness disappeared and swallowing became normal. A single Sievert ionization chamber was passed into the region of the tumor at the time of daily treatments. The average intensity of irradiation in the center of the field was found to be approximately 24 r per minute. The irradiation field in the tumor region was 4 × 7 cm. and 5 × 10

cm. in the 2 surviving patients. The skin showed slight atrophic changes and there was slight submental edema visible at the time of seven-year follow-up.

Four roentgenograms; 2 photomicrographs.

J. A. CAMPBELL, M.D.
Indiana University

Neck Dissection. Hayes Martin, Bernardo Del Valle, Harry Ehrlich, and William G. Cahan. Cancer 4: 441–499, May 1951.

In each of the separate anatomical varieties of mouth and pharynx cancer, namely, cancer of the lip, tongue, nasopharynx, larynx, etc., treatment technics (surgical or radiological) differ or vary greatly. Most of the published reports are largely limited to discussion of the primary lesion, and little consideration is given to what is actually the major problem and one common to all forms of head and neck cancer, namely, the management of cervical metastasis. In this paper, little reference is made to the treatment of the primary lesion and the discussion is directed toward the management of the cervical metastases, specifically by neck dissection. The report is based on about 1,450 cases of neck dissection performed at the Memorial Hospital during the period 1928–50. Statistical data are derived from a consecutive series of 665 operations in 599 patients in 1928–45. In this series, the anatomical diagnoses were proved histologically. The sources of cancer most often requiring neck dissection in this series were the tongue (23.6 per cent of the cases), lip (14.9 per cent) and thyroid (13.8 per cent).

The tentative clinical diagnosis of cervical metastatic cancer must depend upon the discovery by the physician of an enlarged node (or nodes) in the neck. The authors do not believe that incisional biopsy should be done for diagnostic reasons only. They list five basic principles which underlie their indications for neck dissection.

1. There should be definite clinical evidence that cancer is present in the cervical nodes. Acceptance of this principle immediately rules out so-called prophylactic neck dissection.
2. The primary lesion giving rise to the metastasis should have been controlled clinically or, if not controlled, there should be a plan to remove the primary lesion at the same time that neck dissection is performed.
3. There should be a reasonable chance of complete removal of the metastatic cancer.
4. There should be no clinical or roentgenographic evidence of distant metastasis.
5. Neck dissection should offer a more certain chance of cure than radiation therapy.

In the authors' opinion surgical removal of cervical lymphatics offers a better chance of cure than does radiation therapy under average conditions, that is, in cases in which the primary lesion is already under control or in which it can be removed at the same time that neck dissection is performed. Under certain circumstances, however, neck dissection does not offer as good a chance for cure as does radiation therapy. In cases in which the primary lesion is anatomically inoperable, as, for instance, in nasopharyngeal cancer or an extensive cancer of the tonsil, the pharyngeal wall, or the extrinsic larynx, treatment of the primary lesion obviously must be by irradiation. In such cases, in which any cervical metastasis is present, the authors believe treatment to the metastasis should also be by irradiation therapy. They list the following general principles upon which their current practices are based.

1. In cervical metastatic cancer, surgery (neck dissection) is the procedure of choice in the majority of cases, since it is the most direct, the most readily controlled, and the most predictable method of therapy.
2. Radiation therapy is an indispensable method for the initial treatment of cervical metastasis in selected cases. It is also useful, and often permanently successful, in the treatment of inoperable recurrences following neck dissection.

The authors discuss the controversial question of the propriety of a prophylactic neck dissection. They present the results of a survey by questionnaire among 75 cancer therapists and present the reasons why they feel that prophylactic neck dissection is not a justifiable surgical procedure.

The surgical anatomy of neck dissection and the surgical technic involved are described. In discussing recurrences following neck dissection the authors emphasize that radiation therapy should be employed and that a definite percentage of these patients may be salvaged and their disease permanently controlled. Roentgen ray irradiation in combination with implantation of radon seeds is considered the treatment of choice. The technical factors are listed in successful (five-year cure) cases; with 250 kv., the median dose was 5,000 r with a range of from 3,000 to 8,000 r. The median dose of supplementary gold seeds in the successful cases was 20 millicuries.

In the 599 patients with 665 neck dissections a recurrence was observed in 65.5 per cent, and of these patients 15.6 per cent were cured at the end of five years. One hundred and eighty-one patients, or 30.2 per cent of the series, had no recurrence and were considered as free of disease at five years. The authors list the factors which influence the prognosis in patients with neck dissection. No patient with a primary lesion in the nasal cavity, nasopharynx, pharyngeal wall, extrinsic larynx or paranasal sinuses who developed cervical metastasis and was treated by neck dissection survived five years. Results are further considered according to the pathology of the primary lesion, chronology of the cervical metastasis, number of nodes involved, and postoperative recurrences.

Twenty-eight figures; 6 tables.

D. S. CHILDS, JR., M.D.
Rochester, Minn.

Roentgen Rotation Therapy in Cancer of the Esophagus. Dosage Problems. Preliminary Results. Inge Gynning. Acta radiol. 35: 428–442, May-June 1951.

For rotation therapy of esophageal carcinoma as practised in the King Gustaf V Jubilee Clinic, Lund, Sweden, the patient is placed in a revolving chair with the x-ray tube stationary. A fluoroscopic screen is employed to keep the size of the field constant in each treatment and to control the position of the tumor in the treatment field.

Since in these cases the total dose approaches tolerance levels, the tumor dose must be carefully determined. Direct measurement in the esophagus is made

with Sievert ionization chambers introduced by means of specially constructed bougies. Daily tumor doses of 200 to 225 r were found best to meet the requirements, being as high as possible without causing severe local reaction. Doses of 100 r were considered inadequate. Total tumor doses of 6,500 r in thirty-five days and 6,800 r in forty days were found to be optimum by clinical evidence. Doses of this magnitude demand exact measurement if overdosage complications are to be avoided.

Treatment was completed in 77 cases over a four-year period, with a minimum observation time of three years. Distinct improvement was noted in 70 patients with 50 recorded as completely free of signs after completion of treatment. Eight patients remained free of evidence of disease after three years (1 for six years, 4 for five years).

The author feels that, although the therapeutic results may not be considered good numerically, they are encouraging in view of the age of the patients, advanced stage of disease, and problems of technic and dosage control. He believes that rotation therapy has great value in inoperable cases and that with wider experience it may prove to be applicable also in operable cancers in the middle and upper thirds of the esophagus.

Eleven figures, including 18 roentgenograms; 2 tables.

J. DURLACHER, M.D.
Indiana University

A New Method for the Treatment of Cancer of the Lungs by Means of Artificial Radioactivity (Zn^{65} and Au^{198}). First Experimental and Clinical Studies. J. H. Müller and P. H. Rossier. Acta radiol. **35:** 449–468, May-June 1951.

The authors describe a previously undeveloped procedure for "selective" irradiation of lung tissue with a short-lived and chemically innocuous artificial radioactive isotope. Au^{198} in the form of a pectin precipitate with a particle size of 30–50μ was finally chosen after two earlier attempts with Zn^{65}. By intravenous injection diffuse microemboli in lung tissue are obtained. The best distribution of the radioactive material was obtained by cardiac catheterization and injection into the proper pulmonary artery or its segment. This was accomplished by an infusion device through which an infusion of the patient's own heparinized blood was made immediately afterward under mild pressure. Up to 140 millicuries were injected with only a 25 per cent loss in the injecting system.

The calculated dose in the treated lung and the results from direct measurement on the chest wall by means of the thimble chamber of the integron-dosimeter were in good agreement.

The first patient was a 42-year-old man with generalized Hodgkin's disease who responded remarkably and was later able to receive conventional radiation therapy. The other three patients had inoperable, quite hopeless bronchial carcinoma. In 2 cases coming to autopsy at thirteen and twenty-six days respectively, complete studies of the distribution of the radiogold were made.

Aside from the lung, the spleen and liver were the organs showing the highest degrees of radioactivity. In one case activity of the spleen was 5.8 per cent and that of the liver 5 per cent of that of the injected segment of lung. Histologic sections of the spleen showed the particles it contained to be 25 mm. or less in diameter, indicating the importance of an average particle size of 30 mm. in the injected material.

This method of therapy may be combined with intrapleural or intratumoral injections of colloidal Au^{198}, as well as with conventional radiotherapy or surgical procedures.

Six autoradiographs; 2 photomicrographs; 2 tables.

D. C. GASTINEAU, M.D.
University of Arkansas

Growth and Spread of Cancer of the Cervix Uteri. Gray H. Twombly and Salvatore di Palma. Am. J. Roentgenol. **65:** 691–697, May 1951.

Too little attention has been paid to the natural history of carcinoma of the cervix. The pre-invasive phase or carcinoma *in situ*, first described in 1912, did not achieve wide recognition until after 1933, and only since the use of the Papanicolaou method have many cases been detected in this stage. That the disease may begin as an *in situ* lesion has not been completely proved, although the concept that preinvasive carcinoma precedes cancer of the cervix has become more convincing, having been demonstrated in a large percentage of cases by means of serial sections. It would appear that carcinoma *in situ* may precede invasive carcinoma by from eight to twelve years, as shown by the average age of patients, those having preinvasive lesions being thirty-six to forty-one years of age and those having an infiltrative carcinoma averaging forty-nine years. Apparently, therefore, the preinvasive form exists for a relatively prolonged period, during which the prospect of cure would be close to 100 per cent.

Analysis of a series of 171 untreated cases seen between the years 1930 and 1941 indicates a 58 per cent mortality within one year of the onset of symptoms and an 82 per cent mortality before two years. The five-year-survival rate in this untreated group was only 4.6 per cent.

In a series of 91 cases in which a radical hysterectomy was done the primary spread was found to be predominantly by local extension, over half of the cases showing invasion of the parametrial tissue, whereas only 16.5 per cent had evidence of regional node involvement. Of the nodes involved, those of the obturator fossa are the most common sites of metastases, with the hypogastric node being next in frequency of involvement. Sites of late metastases include most commonly the peri-aortic or retroperitoneal lymph nodes. The lung and liver are next in frequency. Bony metastases, except in the spine, are rare. Slightly less than half of a series of autopsied cases (Brunschwig and Pierce: Am. J. Obst. & Gynec. **56:** 1134, 1948) had metastases outside the pelvis.

Parametrial involvement is predominantly in the untreated cases with a relatively lower incidence of node involvement, whereas in treated cases, parametrial cancer has been somewhat controlled and there is a comparative increase in the incidence of positive nodes. There is also an increase in the percentage of peri-aortic nodes involved in the treated cases, suggesting that control of the local disease by irradiation or surgery allows a longer time for metastases outside the pelvis to occur.

The authors conclude that cervical carcinoma is a disease slow to metastasize widely, killing its host by local changes in the pelvis, the most common cause of death being those complications arising from urinary tract obstruction. While it is possible that ureteral

transplantation could decrease urinary tract fatalities, it would seem to be of questionable benefit if the primary tumor cannot be eradicated.

Three graphs; one drawing.

WENDELL WARD, M.D.
University of Arkansas

Results of Surgical Treatment of Cancer of the Cervix Uteri. Joe V. Meigs. Am. J. Roentgenol. **65**: 698–708, May 1951.

In this article the author reports his results in a series of 75 patients in whom radical hysterectomy and bilateral pelvic lymph node dissections were done. There were no postoperative deaths in this series, and the over-all five-year survival rate was 78.7 per cent. All of the cases were Stage I or Stage II on the first clinical visit, and the patients were selected for operation because they were younger, thinner, and in better condition than others with Stage I and Stage II disease.

Although the treatment of these cases was primarily surgical, in some patients with proliferative growth in whom it was felt that recurrence might result from spillage of the tumor in the operative field, preliminary radium and roentgen treatments were given. It is the author's feeling that irradiation and surgery do not go together, and that a firm, hard, fixed pelvis results from combining the two.

In 14 patients (18.7 per cent) lymph nodes were found that were proved to contain cancer. Of these 14 patients, 4 are still living at the end of five years. The iliac and obturator nodes were most commonly involved; one patient had involvement of ureteral lymph nodes. If lymph nodes can be felt running up along the aorta, it is not wise to continue with a radical operation, for this finding means inoperability.

The results of treatment in the non-irradiated group were superior to those in the irradiated group. There were 83.3 per cent five-year survivals in the former and 70.4 per cent five-year survivals in the latter. The author points out that, although the number of cases reported is small, he has observed the same trend throughout the analysis of his series of cases. The five-year survival rates for Stage I cases was 86.3 per cent, and for Stage II patients 62.5 per cent. Of the patients with histologically Grade I lesions, none had positive lymph nodes and 85.7 per cent were living at five years. Of Grade II cases, 19 per cent showed positive lymph nodes, and of Grade III cases 26.7 per cent. The Grade I cases did best and Grades II and III about the same at the end of five-years. In the surgical group, except for deaths from intercurrent disease, no patient had died after two years who did not have positive nodes.

In 10 of the 75 patients uretero-vaginal fistulae developed, but the incidence of this complication has decreased in the more recent cases.

In his conclusion the author states that the results fully justify surgery, but that the number of cases is so few that the whole plan should still be considered as experimental.

Nine tables.

JAMES W. NELSON, M.D.
University of Arkansas

Radiation Treatment of Cancer of the Cervix Uteri. James F. Nolan and Lucille Du Sault. Am. J. Roentgenol. **65**: 709–714, May 1951.

This article deals with the technic of radiation therapy on the basis of dosimetry. Since ionizing radiations, by their very nature, must be traumatic to the tissue, it is best theoretically to deliver a uniform amount of radiation throughout the entire area of possible involvement by the tumor so that the minimum dose needed to control the neoplastic growth may be sufficient and the maximum dose not be exceeded.

Radium is the primary agent in treatment of carcinoma of the cervix, even though both radium and external roentgen rays may be used. The simplest method is by use of an intracervical tandem. With this method the greatest dosage is in the center of the tumor and the radiation falls off toward the margin in accordance with the inverse-square law. A more homogeneous irradiation may be achieved by using a number of weaker sources scattered throughout the tumor. There is a maximum dose which will cause undesirable necrosis, and this necrosis must be kept within a finite volume of tissue so that the allowable exposure by each applicator is limited. Also, it has been demonstrated that there is a vital area in the parametrium, designated the paracervical triangle, in which unfavorable effects follow dosages above certain finite levels. In any case, it is unlikely that the radium will administer sufficient dosage along the lymph channels.

In administering external radiation, small fields are preferable, placed laterally in the pelvis, especially if radium is also being used. In any course of radiation therapy the best treatment is one which utilizes the available means to their optimum limits, but in which vital areas are protected from over-treatment and irradiation of unnecessarily large volumes of normal tissue is avoided.

The authors analyze 560 cases treated at Los Angeles Tumor Institute between the years 1933 and 1944. Graphs are given to show the incidence of dosages in Stages I, II, and III, relation of dose to result in Stages I, II, and III, and the percentage of success in each stage in patients receiving less than 7,000 r to point "A" and in those who received more than 7,000 r to point "A." Patients with Stage I carcinoma receiving less than 7,000 r did better than those receiving a larger amount, but in Stage II and III cases somewhat better results were achieved by higher dosage. These observations were further investigated in relation to growth type, age of the patient, influence of complications, and a condition termed "supralethal effect." Failures by reason of recurrent disease in the pelvis represented 72 per cent of the 60 patients with Stage I lesions: 34 of these were in the high-dosage group and 9 in the low dosage group. It would appear that the concept of a maximum dose may be borne out in practice. It is noted that in all patients, including Stage IV, the mean life of the patients who died with the disease was greater in those receiving more than 7,000 r to point "A."

Three graphs; 2 tables. GEORGE REGNIER, M.D.
University of Arkansas

End Results of Radiation Treatment of Cancer of the Cervix Uteri. Herbert E. Schmitz. Am. J. Roentgenol. **65**: 715–719, May 1951.

A review of the cases admitted to the Gynecological Service of the Mercy Hospital Institute of Radiation Therapy (Chicago) shows that from May 1, 1933, to May 1, 1945, there were 499 patients with a diagnosis of cervical carcinoma. One hundred and eighty-eight of these, previously untreated, were given planned courses

of radiation therapy and constitute the basis of the author's conclusion that surgery offers no advantage over irradiation in cancer of the cervix. There were included 14 cases of Group I, 44 of Group II, 79 of Group III, and 51 of Group IV (Schmitz' classification).

All patients were treated as follows: 50 mg. of radium element in tandem, filtered by 2 mm. of brass and 3 mm. of para rubber, for 1,500 mg. hr. every eight days for three applications for a total of 4,500 mg. hr. This administers 7,000 gamma roentgens to area A and 1,540 gamma roentgens to area B. On the days the patient was not receiving radium therapy she received daily roentgen treatment to one field. The plan for roentgen treatment was as follows: 800 kv.; 10 ma.; 70 cm. focus-skin distance; filters Pb 1.0 mm., Sn 1.56 mm., Cu 2.62 mm., Al 3 mm.; extension chamber 2 mm. of 3 mm. Cu half-value layer; 56 per cent is obtained at 10 cm.; 250 or 300 r were administered daily, and the number of fields was regulated by the measurement of the patient. A total tumor dose of 3,500 to 4,000 r was given. The five-year cure rate for the series was 43.6 per cent.

The complications of irradiation included cystitis, diarrhea, colitis, dermatitis, vesicovaginal fistula, bowel obstruction, proctitis, and hemorrhage, but were found not to be frequent or severe enough to condemn this method of therapy. The cell type of the disease in no way aided in prognostication. The response of the tumor to therapy and the extension of the disease, however, definitely influenced the prognosis.

Seven tables.

Possibilities of Radical Surgery in Cancer of the Cervix Uteri Recurrent after Radiation Therapy. Alexander Brunschwig. Am. J. Roentgenol. **65**: 720–725, May 1951.

Patients having recurrent or persistent carcinoma of the cervix uteri after initial radiation therapy generally have a poor prognosis. A second attempt to control the disease by radiation may be successful in some instances but restraint of growth is usually the best that can be expected. For the past two and a half years the Memorial Hospital (New York) has pursued a surgical program for patients of this type. Three groups are considered.

The first group consists of patients with recurrent persistent carcinoma limited to the cervix, with or without vaginal, parametrial, and pelvic lymph node invasion. These patients were treated by means of radical hysterectomy with pelvic lymph node excision, in an operation somewhat more extensive than the so-called Wertheim procedure. Of 17 patients operated upon, 9 were living and well at the time of the report; the remaining 8 had recurrence or had died at varying intervals following operation. For those living and well, the interval following operation ranged from eight months to two years and five months.

In the group in which carcinoma has invaded the bladder a partial pelvic exenteration is performed. This operation consists of removal of the vagina, uterus, adnexa, pelvic lymph nodes, and bladder, with implantation of the ureters into the colon. A total of 42 patients were thus treated, of whom 29 were in the group under consideration. Among these patients 6 were living and well for periods from a few weeks to two years and five months after operation. One patient lived for a year and died suddenly of unknown cause, but had been free of disease in the pelvis three weeks previously.

For patients having carcinoma involving both bladder and rectum a complete pelvic exenteration is performed, *i.e.*, removal of bladder, vagina, uterus, adnexa, and colon. There were 53 patients in this group. One patient, living after two years and eight months, was operated upon because of extensive radiation necroses, without evidence of residual carcinoma. Of the other patients, all of whom had recurrent cancer, 4 were alive two years or more after operation and 5 one year and one month to one year and seven months. The remainder were either dead of recurrences or had survived for only a few months. Surgical mortality (*i.e.*, death within thirty days, regardless of cause) for both the partial and complete pelvic exenteration operations is approximately 23 per cent.

GEORGE REGNIER, M.D.
University of Arkansas

Individualized Interstitial Irradiation of Cancer of the Uterine Cervix Using Cobalt 60 in Needles, Inserted through a Lucite Template. A Progress Report. Joseph L. Morton, Allan C. Barnes, George W. Callendine, Jr., and William G. Myers. Am. J. Roentgenol. **65**: 737–747, May 1951.

On the basis that predetermined positions for parametrial needles would reduce the problem of determining accurately the extent and position of the tumor in supporting tissues, and that such placement of needles would provide a uniform theoretical dosage distribution in the pelvis, the authors devised a template for the placement of parametrial and intra-uterine needles made of cobalt^{60}.

Patients with carcinoma of the cervix in League of Nations Stage III and IV were selected for treatment. External irradiation was applied first. Thereafter the patients were carefully examined, and accurate measurements were taken of the size and position of the tumor, the position of the cervical face, the size and relation of the uterus and cervix to the pelvis, vagina, rectum, and bladder, and the size and location of the parametrial masses. The size of the vagina was determined by palpation and by the insertion of a series of graduated gauges resembling the templates to be chosen.

Thereafter an applicator was prepared for the individual patient, allowing for placement of the needles so that a homogeneous irradiation pattern in the pelvis as well as for the cervical carcinoma could be obtained. The needles are constructed by inserting cylinders of radioactive cobanic wire in stainless steel sheathing and spacing them in the desired positions with aluminum wire or graphite spacers. As a safety precaution the points of the needles are blunted. The needle butts are bent, which facilitates insertion and prevents migration during the period of treatment. The template itself is made of lucite.

The authors report upon 9 cases treated to date. Puncture of the bladder is known to have occurred in 1 case and is suspected to have existed in a second case. There have been no serious sequelae on cystoscopic follow-up of these cases. Although puncture of the ureters constitutes a theoretical hazard, this accident has not been recognized. The patients in this series tolerated the treatment remarkably well. The ultimate results could not be described in view of the brief period of observation.

Fifteen roentgenograms; 4 drawings.

I. MESCHAN, M.D.
University of Arkansas

Studies of the Dosage Distribution in the Pelvis in Radium Treatment of Carcinoma of the Uterine Cervix According to the Stockholm Method. H.-L. Kottmeier. J. Faculty Radiologists **2**: 312–319, April 1951.

The author summarizes the Stockholm method of treatment of cancer of the cervix and includes five-year results for 1,965 cases of Stages I to IV, treated in the period 1938–44 at the Radiumhemmet.

Dose distribution studies based on the current method of treatment are discussed and the incidence and type of injury to bladder and rectum are explained and analyzed. Rectal reaction is, in the opinion of workers at the Radiumhemmet, the direct result of over-irradiation of the rectum, which differs from the opinion held and expressed by the Manchester school which considers "Point A" the limiting tolerance area in the production of "extrinsic rectal reaction."

Phantom measurements show that the maximum dose to the rectum in the Stockholm method of treatment is in the anterior wall directly posterior to the center of the vaginal radium applicator. Furthermore, the dose in this area is dependent to a considerable extent on the vaginal radium even if the uterus is retroverted.

A study was made of dosage distribution in 20 cases of cancer of the cervix with the aid of Sievert's condensor chamber measuring 15 by 9 mm. The average maximum dose measured in the bladder was 4,410 r, but in a case of marked anteflexion of the uterus the maximum bladder dose was 7,500 r, while with marked retroversion the figure was 1,800 r. The important point is made that the intra-uterine radium is responsible for a greater percentage of dose to the urinary bladder than is the vaginal radium. At the level of the trigone, the intra-uterine radium is responsible for about 75 per cent of the dose. In the posterior wall of the bladder the proportion is even higher.

With uterine and vaginal radium the rectum received a maximum dose at the level of the lower part of the cervix, averaging 3,920 r. The vaginal radium was, on the average, responsible for 65 per cent and the intrauterine radium for 35 per cent of the dose to the rectum.

Direct dose measurements were also made in the parametria. This was done by means of bilateral extraperitoneal lymphadenectomy performed twenty-four hours after radium was applied, and while it was still in place. Similar points were measured in all patients studied. The dose to the lateral pelvic walls ranged between 2,240 r and 610 r, the variations depending upon the degree of lateral displacement of the uterus. The average dose received by the area in which the parasacral nodes are situated was 1,470 r, the vaginal and intra-uterine radium each being responsible for about 50 per cent of the dose.

Three illustrations; 4 tables.

RICHARD A. ELMER, M.D.
Emory University

A Correlation of Histologic Grade, Clinical Stage, and Radiation Response in Carcinoma of the Uterine Cervix. Robert W. Kistner and Arthur T. Hertig. Am. J. Obst. & Gynec. **61**: 1293–1300, June 1951.

The authors have attempted to correlate the five-year survival rate in carcinoma of the cervix with three variables: (1) the histologic grade of the tumor at the time of the first biopsy, (2) the clinical stage of the tumor at the time of diagnosis, (3) the response of the tumor to radiation, as determined histologically.

Three hundred and fifty-four cases were reviewed in order to obtain a series of 100 cases in which serial biopsies had been taken and were available for study and in which all radiation therapy had been given at one institution. The usual program of radiation therapy began with deep x-ray therapy (200 kv.p.) for a period averaging three weeks with an average total dose of 6,000 r. Radium therapy followed the deep x-ray therapy, being given in two courses of 2,000 to 3,600 mg. hr. each, the second course being given within ten to twenty-one days of the first. Biopsies were performed at the time of diagnosis, before the first implantation of radium, before the second implantation of radium, and at the termination of radium therapy (or two to three weeks later).

In the 100 cases studied, the age range was from 25 to 77 years, with an average of 49.8 years. Thirty-four of the cases were of Stage I, 53 Stage II, 9 Stage III, and 4 Stage IV. Four cases were histologic Grade I (well differentiated), 77 Grade II, and 9 Grade III squamous-cell carcinomas. There were 9 adenocarcinomas and one adenosquamous carcinoma. The over-all five-year survival rate in this group of 100 cases was 50 per cent.

The authors believe that there is a definite relationship in their series, as in others, between clinical stage and five-year survival. The five-year survival rates for each stage compared favorably with those reported from other institutions. The observations indicate that the survival rate cannot be predicted with any degree of accuracy from the histologic grade of the tumor. The radiation response of histologic Grade II and III tumors was somewhat better than that of Grade I and of adenocarcinoma. There seemed to be an increase in the survival rate in those patients who had demonstrated a marked reaction to radiation. However, when these cases were analyzed according to stage, it was found that they were all Stage I and II, and it was felt that the clinical stage was probably the most important factor affecting survival. The authors suggest surgery as adjunctive therapy in those cases where there is histologic evidence of minimal response to radiation therapy.

Eight charts.

T. FREDERICK WEILAND, M.D.
Jefferson Medical College

Place of X-Ray Therapy in the Treatment of Malignant Ovarian Tumours. Margaret C. Tod. J. Obst. & Gynaec. Brit. Emp. **58**: 385–387, June 1951.

Little is known of the actual value of x-ray therapy in the treatment of malignant ovarian tumors. In early cases it is always an addition to surgery; and it is only in the late cases, where tumor is known to have remained, that it is possible to claim that a cure was achieved by irradiation. The "late" case is that with a large, very malignant, inoperable cancer, so that not many are cured. However, in a series of 125 patients with cancer of the ovary treated by x-rays at the Holt Radium Institute between 1940 and 1944, the five-year crude survival rate was 30 per cent.

Two methods of radiotherapy are possible: (1) The smallest possible volume of tissue which can be regarded as likely to contain the whole tumor can be irradiated to the highest dose which the local tissues will tolerate. (2) The whole region likely to be involved by the tumor and the most probable sites of secondary deposits, *i.e.*, the whole peritoneal cavity from the pouch of Douglas to the upper aortic lymph nodes, can be

irradiated to the highest dose which systemic tolerance will allow. In the Holt Radium Institute the second method has been chosen, as it is believed that the local tolerance of the pelvic tissue is not enough greater than that of the whole peritoneal cavity to allow a sufficiently high dose to justify leaving much potentially invaded tissue unirradiated. A device is used to insure the homogeneous irradiation of large volumes, called the "trunk bridge," and the whole peritoneal cavity is treated by four oblique fields usually 30 × 20 cm. When the patient is tall, longer fields are needed and 40 × 20 cm. fields can be arranged. If care is taken not to go too fast, the same dose can be attained.

It is essential for this method that the daily input rate should be very low at first and gradually increased. In practice, the author begins with 35 r to each of the four fields, increasing by 5 r per day to 80 r per day. The total dose delivered homogeneously throughout the volume treated is 3,000 r in twenty-eight to thirty days. If the daily input rate is correct there is little trouble with radiation sickness, although slight nausea may occur. The best indicator of tolerance is the white blood cell count, which should be obtained prior to treatment, at the end of ten days, and then twice weekly until the course has been completed and the number of cells is seen to be rising. A fall to 300 monocytes is regarded as a danger signal, particularly if the fall is suddenly accelerated, but the treatment may be continued provided the total count does not fall below 2,000 and the patient's condition is good. It is not, of course, believed that the tumor dose of 3,000 r in four weeks is likely to be lethal to more than a fraction of the tumors, those which fall into the sensitive range, but it is the highest that can be obtained without exceeding the tolerance of the average patient.

Of 19 patients with cancer of the ovary, with no known residue following surgery, 15 survived five years (79 per cent); of 83 patients, with residue, who were completely treated, 23 were alive at the end of five years (28 per cent).

The author is convinced that if the gynecological surgeon would realize that the radiotherapist offers a partnership most profitable for the patient, it would soon become a matter of course that every ovarian tumor proved to be malignant would receive postoperative irradiation.

Two photographs; 4 tables.

Hemangioma with Purpura, Thrombocytopenia and Erythrocytopenia. Maxwell Bogin and James Thurmond. Am. J. Dis. Child. **81**: 675–680, May 1951.

A case is presented of a boy with a congenital hemangioma with the development of purpura with thrombocytopenia and erythrocytopenia at six weeks of age. The hemangioma was effectively treated with radium applications. When conservative therapy, consisting of transfusions and irradiation over the spleen, failed to improve the bleeding tendency, splenectomy was resorted to. Improvement thereafter was gradual but definite.

In a review of the literature the authors found 3 cases of hemangioma with associated purpura. They conclude that the findings are coincidental, representing separate disease entities. Further observations and reports are invited.

Three photographs. ALLIE WOOLFOLK, M.D.
Mercy Hospital, Pittsburgh

Vertebral Hemangioma with Compression of the Spinal Cord. Report of a Case Treated with Roentgen with Good Clinical Results. Inge Lindqvist. Acta radiol. **35**: 400–406, May-June 1951.

A case of vertebral hemangioma with cord compression diagnosed clinically and roentgenologically was treated successfully with radiation therapy. The patient was a youth of 18 years with bilateral spastic paresis of the lower extremities. Complete subjective and objective relief was obtained except for slight numbness of the feet, hyperactive deep reflexes, and a suggestion of clonus of the foot. The treatment was fractionated over nine months with a total tumor dose of 2,100 r delivered by external irradiation. The radiographic appearance of the vertebral body remained unchanged in spite of the clinical improvement.

Vertebral hemangioma is not infrequently an incidental finding at autopsy but seldom registers clinically. The symptoms may range from localized tenderness to transverse myelitis if sufficient cord compression exists. Pathological fractures are rare, indicating a normal resistance to stresses and strains.

The prognosis of vertebral hemangioma producing cord compression is poor unless treated surgically or radiologically. Surgery is designed to relieve compression, and its success is dependent to a high degree upon the control of hemorrhage.

Four roentgenograms. JOHN W. WILSON, M.D.
Indiana University

Rhinoscleroma. Report of a Case. C. S. Chu, S. C. Hsiao, and T. T. Chu. Chinese M. J. **69**: 234–238, May-June 1951.

Rhinoscleroma is a rare form of granuloma, apparently infectious (Frisch bacillus), usually involving the nose but sometimes extending to practically the entire respiratory tract. Clinically there are three stages: (1) a diffuse chronic rhinitis with marked crusting, (2) a circumscribed stage in the form of coalescing nodules, and (3) cicatricial contraction, which may cause a pronounced stenosis of the air passages. Biopsy must be done to rule out lupus and other chronic granulomata.

Irradiation was formerly the treatment of choice, but streptomycin has proved very effective. This drug was not available to the authors for use in the case reported. Instead they cleared up the lesions with rather heroic doses of roentgen (4,000 r) and radium (1,080 mg. hr.) radiation. It is not stated how many areas were treated, over what period of time the radiation was delivered, or whether the 4,000 r represented air, skin, or tissue dose, nor is the voltage given. The patient had involvement of the nose, nasopharynx, oral pharynx, and epiglottis. After eighty-seven days the lesions had largely disappeared (no further follow-up).

One photomicrograph. ZAC F. ENDRESS, M.D.
Pontiac, Michigan

Serial Gastric Biopsy Studies in a Case of Duodenal Ulcer Treated by Deep X-ray Therapy. R. K. Doig, J. F. Funder, and S. Weiden. M. J. Australia **1**: 828–830, June 9, 1951.

The authors report a case of duodenal ulcer in which deep x-ray therapy was given to the stomach, comment on the histologic changes, and seek to correlate histologic findings with multiple gastric analysis.

Therapy was administered anteriorly and posteriorly through 10 × 12-cm. portals after localization of the

stomach radiographically. With an h.v.l. of 2.5 mm. Cu, at 50 cm. distance, 1,970 r (skin dose) were given to each portal in increments of 219 r per session. Biopsies were taken on days 1, 21, 38, 66, 136, 374, and 475.

Prior medical treatment had given no more than two to four months freedom from symptoms. At the time of this report, seventeen months after irradiation, the patient was without complaints.

The biopsy studies and their correlation with hydrochloric acid and pepsin secretion are well outlined. A profound histologic reaction of the gastric mucosa to irradiation occurred but all changes had cleared within a year following therapy.

Ten photomicrographs; 1 graph; 1 table.

JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

RADIOISOTOPES

(See also under Radiotherapy)

Circulating Red Cell Volume and Body Hematocrit in Normal Pregnancy and the Puerperium by Direct Measurement, Using Radioactive Red Cells. William L. Caton, Charles C. Roby, Duncan E. Reid, Randolph Caswell, C. J. Maletskos, Rex G. Fluharty, and John G. Gibson, II. Am. J. Obst. & Gynec. **61**: 1207–1217, June 1951.

The authors were able by means of the radioactive iron tagged red cell technic to make direct measurements of the red cell volume during pregnancy and the puerperium. Because the results of this technic are independent of variations in the hematocrit-plasma ratio throughout the vascular system, a true measurement of the circulating red cell mass can thus be obtained.

All previous determinations of the circulating red cell volume during pregnancy have employed indirect methods.

Results of the study are reported in detail.

Three charts; 2 tables.

Scintillation Counter in Clinical Studies of Human Thyroid Physiology Using I^{131}. Herbert C. Allen, Jr., Raymond L. Libby, and Benedict Cassen. J. Clin. Endocrinol. **11**: 492–511, May 1951.

Scintillation counters [see Allen *et al.*: Radiology **58**: 68, 1952], because of their high sensitivity to gamma radiation, have made possible an extension of the usefulness of radioactive tracers, particularly in clinical studies.

With the so-called "wide-angle" scintillation counter, reliable thyroid uptake studies can be made with doses of eight-day radioactive iodine as small as 1 to 10 microcuries, amounts which expose the patient to less radiation than do some of the more common routine diagnostic procedures.

The "directional" scintillation counter affords a means of outlining the frontal and lateral silhouettes of the lobes of the thyroid, from which the volume and weight of the gland can be calculated with greater accuracy than has hitherto been possible. Since determination of the size and weight of the thyroid is an essential step in estimating dosage, the new counter thus becomes of value as a therapeutic aid. As a diagnostic agent it permits a precise *in vivo* determination of the relative distribution of radioactive iodine in the thyroid and a recognition of hyperfunctioning nodules or of non-functioning nodules in a diffuse hyperfunctioning gland. It has proved useful also in demonstrating the extent of a previous subtotal thyroidectomy or the completeness of a total thyroidectomy by outlining the residual thyroid tissue, when operative data are unavailable. Like the "wide-angle" counter, it too can be used as an instrument for determining radioiodine uptake, though larger doses of the isotope are required than with the former instrument.

The two counters are described and the technic of their use is outlined.

Eight illustrations; 2 tables.

Effect of Complete Ablation of Thyroid Tissue by Radioactive Iodine on the Survival of Tumor-bearing Mice. Henry A. Sloviter. Cancer Res. **11**: 447–449, June 1951.

This study was undertaken to evaluate the effect of ablation of thyroid tissue by radioactive iodine on the survival of tumor-bearing mice.

Inbred mice of the C3H strain were used in the investigation. Either of two fibrosaromas originally induced in mice of this strain by methylcholanthrene was implanted by subcutaneous injection into the right axillary region. Radioactive iodine, I^{131}, was administered by a single subcutaneous injection at a site distant from the tumor; in one group of animals the isotope was injected after the tumor had grown to appreciable size and in another group either thirty-four or one hundred and three days prior to implantation. In each instance the number of days that elapsed between tumor implantation and death of the mouse was recorded as survival time. The dosage of radioactive iodine was 250 μc. per mouse, except in one experiment in which the dosage was 210 μc. A dose of 200 μc. is thought to be sufficient to destroy all thyroid tissue in the mouse.

It was found that the average rate of growth of the tumors and the average period of survival of the mice in which thyroid tissue had been ablated were not significantly different from those of untreated tumor-bearing mice. It is concluded that thyroid ablation has no significant effect on tumor growth.

Two tables.

Tracer Studies of Radioactive Sodium Estrone Sulfate (S^{35}) in Cases of Advanced Breast Cancer. Edward F. Lewison, J. Elliot Levi, Georgeanna S. Jones, Howard W. Jones, Jr., and Hannah E. Silberstein. Cancer **4**: 537–548, May 1951.

An investigation of radioactive sodium estrone sulfate in the tracer study of human cases of advanced breast cancer was designed to determine where and possibly how estrogenic steroids may interfere with the dynamics of breast cancer. It would be of major importance to know whether the sex steroids act directly on the cancer cell itself, upon the surrounding mammary substrate, or through related glands of internal secretion.

Tracer doses of sodium estrone sulfate labeled with S^{35} were used. Studies of distribution of the radioactive S^{35} were made in 6 rats, in 7 women with breast carcinoma, and in 1 woman with carcinoma of the cervix. In the rats the greater part of the radioactivity was promptly excreted in the urine. A tissue con-

centration in the various organs is presented in a table showing that the gastro-intestinal tract and contents, bone marrow, uterus, cervix, and vagina are among the organs which contain the greatest concentration. In the women a large portion of the radioactivity was promptly excreted in the urine. In those with breast cancer an increased concentration was found in the carcinoma itself. The authors conclude that the concentration of radioactivity in the tumor tissue is notably higher than could be accounted for by random distribution throughout the body.

Five figures; 2 tables.

D. S. CHILDS, JR., M.D.
Rochester, Minn.

Radioautographic Visualization of Sulfur-35 Disposition in the Articular Cartilage and Bone of Suckling Rats Following Injection of Labeled Sodium Sulfate. Dominic D. Dziewiatkowski. J. Exper. Med. **93**: 451–458, May 1951.

The author has previously reported (J. Biol. Chem. **178**: 931, 1949; **189**: 187, 1951) that with intraperitoneal administration of sulfur^{35} in the form of sodium sulfate to suckling rats, the isotope was demonstrable in the knee joint cartilage during the following 164 hours. Furthermore, chondroitin sulfate with the radioactive sulfur^{35} incorporated therein has been isolated after administration of this isotope as sodium sulfate. The present paper reports experiments utilizing radioautographic technics to demonstrate the location of the radioactivity in sections of humeri and tibia-femur combinations removed 24, 48, 96, 216 and 290 hours after the injection of the isotope into suckling rats.

Radioautography of sections of bone and cartilage that had been fixed in formalin indicated that the tracer isotope was present throughout the entire epiphysis. Its concentration was highest initially at the epiphyseal-diaphyseal junction, where the more mature cartilage cells were present. By the 96th hour after injection the sulfur^{35} had become more uniformly distributed in the epiphyses and an even distribution throughout the epiphyseal cartilage was attained by the 216th hour.

As centers of secondary ossification arose in the epiphyseal cartilage, the sulfur^{35} appeared to diminish in concentration and disappear from these sites. However, radioautographs of cartilage fixed in formalin saturated with barium hydroxide, instead of in formalin only, disclosed the fact that the tracer isotope was still present in these foci.

When bone and bone marrow were fixed in formalin the autographs indicated the presence of sulfur^{35} primarily in the periosteum. Only a negligible amount appeared to be present in the bone shaft and marrow. However, when these tissues were fixed in formalin saturated with barium hydroxide, it was possible to demonstrate the presence of the tracer isotope in both bone and marrow.

Two plates, including 10 radioautographs and 1 photomicrograph.

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Continuous γ-Radiation of β-Emitters. Letter to the Editor. L. Madansky and F. Rasetti. Phys. Rev. **83**: 187–188, July 1, 1951.

It has long been known that a weak continuous γ-radiation is emitted in the β-decay of nuclei. The increased efficiency of detection of γ-radiation permitted by the use of scintillation counters led the authors to further investigation of this phenomenon. It was found that about one gamma quantum above 90 kev energy is emitted for every 400 beta rays from P^{32}. This is not the well known *Bremsstrahlung*.

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RADIATION EFFECTS

Generalized Herpes Zoster: Report of a Case Following Roentgen Ray Therapy, Associated with Chronic Lymphatic Leukemia, Leukemia Cutis and Mikulicz's Syndrome. Edward L. Bosworth. Arch. Dermat. & Syph. **63**: 772–776, June 1951.

Two types of generalized zoster have been established. In the first there is successive involvement of different levels corresponding to the zonal distribution of a cranial or segmental nerve, accompanied by pain and other symptoms of the initial zoster lesion, no matter how many different areas are involved. The second, more frequent type is that in which the local zoster is followed by a scattered chickenpox-like eruption which is painless and heals without scarring. A third type, the so-called "vesicules aberrantes," in which a small number of scattered vesicles appear at various sites removed from the initial lesion, has also been described. This is said to be relatively common.

A case of generalized herpes zoster of the second type, associated with lymphatic leukemia, an unusual form of leukemia cutis, and Mikulicz's syndrome, is presented. In this case the zoster developed following roentgen therapy for the leukemia. The patient was given chloroamphenicol (chloromycetin®) and priscoline and two 500 c.c. transfusions of whole blood. The zoster lesions responded promptly to treatment with boric acid compresses and calamine lotion. After discharge from the hospital, additional transfusions were given and the roentgen therapy was resumed. The leukemia lesions were easily controlled with irradiation. No other zoster lesions developed.

Whether herpes zoster in leukemia is due to a primary infiltration of the central nervous system or peripheral ganglions with leukemic cells or whether these cells are secondary to the damage caused by the specific virus remains an unsettled question.

One photograph.

Development of Basal Cell Epithelioma as a Consequence of Radiodermatitis. Nelson Paul Anderson and Harold E. Anderson. Arch. Dermat. & Syph. **63**: 586–596, May 1951.

Various articles have appeared in the medical literature concerning the development of carcinoma as a consequence of radiodermatitis. One of the most complete studies is that by Saunders and Montgomery (J. A. M. A. **110**: 23, 1938), who analyzed 259 cases of chronic and radium dermatitis in which there occurred 27 epitheliomas, all of the squamous-cell type. It has become accepted almost as a fact that all carcinomatous degenerations of radiodermatitis are prickle-cell in character. To show that this is not necessarily true, a number of cases in which the ensuing carcinoma was of the basal-cell variety are reported.

Ten of the cases observed were somewhat similar. In these cases the great majority of the lesions occurred either in the exact midline of the face, *e.g.*, forehead, alae nasi, columella of the nose or the tip of the chin, or in the malar regions. These areas are those subject to "overlapping" in roentgen treatments or in which, as with the malar regions, an error in distance measurement would cause considerable increase in the dose of radiation delivered (inverse-square law). The eleventh case is somewhat analogous to a case reported by Scharnagel and Pack (Am. J. Dis. Child. **77**: 647–651 1949. Abst. in Radiology **54**: 636, 1950). The patient had superficial epitheliomatosis developing in both irradiated and non-irradiated areas years after radiation injuries had occurred (following Tricho treatments to destroy unwanted hair). Those in the normal or non-irradiated skin remained as typical lesions of superficial epitheliomatosis. Those which developed in areas injured by irradiation became elevated and fungating, and their histologic appearance was that of adenoid basal-cell epitheliomas as contrasted with the multicentric picture presented by the lesions in normal skin.

The objection may be raised that histologic proof is lacking of the actual development of basal-cell epithelioma in an area of radiodermatitis. In the authors' cases all the lesions were removed by electrosurgical procedures after sufficient tissue for microscopic studies had first been secured by means of a punch or a curet. The criticism that there was a failure to confirm the diagnosis of radiodermatitis histologically in such cases may with equal justice be extended to many, although not all, the reports dealing with the development of prickle-cell epitheliomas subsequent to radiodermatitis.

One illustration.

Secondary Radiation Limits in Photofluorography. Willard W. Van Allen. Pub. Health Rep. **66**: 712–716, June 1, 1951.

In 1949 the National Advisory Committee on X-ray and Radium Protection, National Bureau of Standards, recommended that the maximum tolerance dosage for personnel exposed to general roentgen radiation be set at 300 milliroentgens per week. Many feel that this limit is too high, especially under conditions where very susceptible parts of a technician's body may be exposed. Since no definite proof of the safety of this rate can be available for several generations, the objective of all concerned with radiation protection should be to keep the level not only below the arbitrary maximum but *as low as possible;* nothing less than maximum safety should be tolerated.

The Electronics Laboratory of the Division of Chronic Disease and Tuberculosis, U.S. Public Health Service, has measured the radiation levels encountered in a wide variety of photofluorographic equipment used by the Division in mass chest x-ray surveys and prepared radiation field maps on the basis of this information. These maps indicate the amount of radiation exposure of personnel working in each type of x-ray installation Two such field maps are presented in the present article, one for a typical portable photofluorograph and the other for a typical mobile installation, both representing the best conditions found in the study. In each of these it should be possible to limit radiation dosage to about 40 mr. per 1,000 exposures for a technician, and to 30 for a clerk in the mobile installation. With the portable unit, irradiation of clerical personnel can be even less if reasonable care is taken in locating them at positions affording maximum protection.

Radiation monitoring by means of dental film badges in the recent Los Angeles County mass x-ray survey gave figures very close to these. Monitoring programs, utilizing either ionization chambers or dental film badges, should serve as a check on the efficiency of the protection given and against carelessness of workers.

In the Los Angeles survey, monitoring tables were kept for 150 employees assigned to 40 photofluorographic units during the twenty-six weeks of operation. Some technicians, evidently careless, received more than "normal" amounts of radiation on several different units, while others on the same units did not receive overdoses. Several technicians on one of the units received overdoses, some of them repeatedly. This is clear evidence of inadequate protective measures.

Tabular records of radiation exposure should be kept for individual employees and individual units as a means of indicating failures in the protective system. Protective devices and technics which do not afford maximum protection should be discarded even though their use assures dosages below the tolerance level of 300 mr. per week. The calculation of radiation dosage per 1,000 films is considered more valuable than determination of the weekly dose. AUTHOR'S ABSTRACT

Radiation Effects on Man in Space [including Takata reaction]. Konrad Buettner. Bull. Am. Meteorol. Soc. **32**: 183–185, May 1951.

Cosmic ray heavy primaries (nuclei of elements 3–26) do not reach the surface of the earth. There are enough of them at altitudes above 25 km. to be a possible hazard to life for exposures longer than a few hours. Cosmic ray showers are much increased in the uppermost atmosphere, but the author is unconvinced by the reported unique biologic effectiveness of showers. A few experiments are recorded to show the biologic effect of radio microwaves, but there seems to be no proof that the amounts coming from sun and stars will prove a hazard. Soft x-rays have been recorded at the heights reached by V2 rockets, but that there are any hard x-rays has yet to be shown.

The author considers the possibility of an unknown radiation, allegedly revealed by the so-called Takata reaction, obtained by a flocculation test with mercuric chloride on blood serum (see Abst. in Radiology **58**: 324, 1952). Takata reports that the reaction is influenced by the sunspot cycle, diurnal cycle, living deep in a mine, mountain climbing, and airplane riding. It responded to large doses of x-rays, gamma rays, and neutrons, electrical charging of the body, and inhalation of large ions, but remained uninfluenced by light, ultraviolet radiation, or exercise. Takata postulated a penetrating, ionizing solar radiation. The author working with K. Reissman and E. Topka has in press the results of an unsuccessful attempt to repeat Takata's observations. After correspondence with Takata, these workers were able to carry out the test satisfactorily, but failed to find the correlations with sunlight, sunspots, elevation, etc. R. R. NEWELL, M.D.
San Francisco, Calif.

Effect of X-Irradiation on Intestinal Motility of the Rat. Robert A. Conard. Am. J. Physiol. **165**: 375–385, May 1, 1951.

In this investigation of the changes produced by x-rays on gastro-intestinal motility and the mechanism

by which such changes are brought about, the greatest emphasis is placed on the effects during and immediately after irradiation.

Rats were given sodium pentobarbital (nembutal), the abdomens were opened in the midline and secured in a tank so that the lower half of the animal was immersed in Tyrode's solution, which was maintained at a temperature of 37 to 38° C. A free loop of jejunum was pulled to one side and a segment prepared for recording by placing two small metal hooks through the serosa opposite the mesentery 2.5 cm. apart. The lower hook was pinned to the bottom of the tank and the upper threaded to a kymographic lever with amplification of two and a half times. The x-ray beam was adjusted at a 45° angle so that the center of the beam was directed against the intestinal loop. Dose rate measurements were taken in the solution at the position of the segment to be studied. Physical factors were: 250 kv.p., 15 ma., 1.0 mm. copper and 3.0 mm. bakelite filters, target distance 17 inches; 100 r per minute. Recordings of intestinal motility without radiation were studied, followed by a study of the effects of various doses up to 1,000 r.

Doses of 100 r and above produced a consistent pattern of intestinal response characterized by a latent period of about one minute followed by increased tone and motility, the degree and length of tone rise, in general, increasing with the dose. With doses of 800 r, propulsive motility was found to be accelerated during the first hour, with a tendency to a decrease below normal from the third hour through the third day, and return to normal after the third day. The most striking feature was the shortness of the latent period.

The same technic was used for studying the mechanism and site of action of x-rays on the intestine. Each animal served as its own control. After recording of baseline motility, 200 r was administered and the response for a ten-minute period after the beginning of irradiation was quantitated by planimetric measurement of the area under the tracing. The influence of various agents was then determined by observing their effect on the response to a second 200 r dose administered fifteen to twenty minutes after the first. It was found that the irradiation resulted in a stimulation of the cholinergic nerves. Atropine, adrenalin, nicotine, curare, and tetraethylammonium, which inhibit the action of acetylcholine on the intestine, also inhibited the x-ray response, while physostigmine, which augments the action of acetylcholine, also augmented the x-ray response.

The following procedures were used to determine the site of action of the irradiation: (a) vagotomy; (b) lead shielding of the intestinal loop, leaving the body exposed; (c) lead shielding of the entire body, leaving the intestinal loop exposed. The results of vagotomy and ganglionic blocking agents seem to indicate that the most likely site of action of x-rays on the vagus is at the level of the enteric ganglia of the intestine. The experiments with lead shielding indicated that the response to x-rays was localized in the intestine.

Six illustrations; 1 table.

Experimental Radiation Cataracts. I. Cataracts in the Rabbit Following Single X-Ray Exposure. David G. Cogan and David D. Donaldson. Arch. Ophth. **34**: 508–522, May 1951.

The purpose of the study described here was to obtain quantitative information on the cataractogenic dose from acute exposure to x-rays. It was recognized that acute exposures and the x-radiation did not necessarily simulate the conditions of exposure under which cyclotron and atomic bomb cataracts developed (see Science **110**: 654, 655, 1949), but it is presumed that the pathogenesis of the cataracts is the same whether the exposure is acute or chronic and irrespective of the type of radiation so long as it is from an ionizing source, *i.e.*, x-rays, gamma rays, or neutrons. The generalities that are established with x-ray cataracts may, therefore, be accepted for other types of radiation, and the difference in dosage will have to be determined by further experimentation.

With x-rays of 200 and 1,200 kv. energy in doses of 250 to 3,000 r, the following effects were noted in rabbits ranging from three weeks to three years of age:

Epilation occurred in fifteen to thirty-five days with doses of 1,500 r or greater, coming on sooner and being more profound the larger the dose and the less the energy of the x-rays. The threshold dose for epilation was 1,500 r for the 1,000 kv. and 1,000 r for the 200 kv. level. Little variation in susceptibility was found with age. The same generalizations held for keratoconjunctivitis.

Cataracts likewise occurred with a latent period that was an inverse function of the dose, but, in contrast to the phenomena of epilation and keratoconjunctivitis, the threshold dose for ten-week-old rabbits was 250 r or less, and the latent period for the development of radiation cataracts was much shorter, the younger the animal. With doses of less than 1,000 r (1,200 kv.), cataracts were the only abnormality produced.

Radiation cataract in the rabbit began with (1) an aggregation of vacuoles along the posterior suture line, oftenest at either extremity; (2) granular opacities, either scattered about the suture line or arranged in ring fashion in the paracentral region; and (3) an equatorial collaret beneath the posterior capsules. With the lower doses, the cataract began as scattered granules about the suture, whereas with the higher doses the cataract began as vacuoles at the end of the suture line. These granular opacities were due to epithelial cells, which, instead of forming fibers at the equator, as they do normally, had migrated posteriorly.

Cytological changes in the lens epithelium appeared to be characteristic of irradiation and could be found before any clinical evidence of cataract. The cellular changes consisted in the spotty occurrence of cells having several times the normal complement of cytoplasm and nuclear fragmentation varying from mere budding to frank karyorrhexis.

Twelve illustrations.

Histological and Chemical Alterations Produced in Mouse Epidermis by Soft X-Radiation. M. H. Toosy. Cancer Res. **11**: 361–365, May 1951.

A single dose of 3,000 r soft x-radiation, from a Philips Contact-Cavity therapy machine, was delivered to areas of epidermis of the backs of 200 adult mice. The physical factors were: distance 20 mm., 50 kv., 2 ma., 100 r per second without a filter. Histologic and chemical examinations of the irradiated hyperplastic epidermis were made twenty-one days later, and the data so obtained were compared to those for normal and methylcholanthrene-treated epidermis.

Histologic findings, including the results of cell-type determination, revealed only minor difference between irradiated and methylcholanthrene-treated epidermis.

However, the total calcium of the irradiated epidermis was about 30 per cent less than normal, while that of methylcholanthrene-treated epidermis was about 50 per cent less than normal. No difference was noted in the iodine number of lipids of either, as compared to normal epidermis. The total lipids of the irradiated and methylcholanthrene-treated epidermis were nearly the same, being significantly less than normal. A polarographic study indicated no difference in a reducible substance from the lipids of irradiated epidermis (between half-wave potentials of unbuffered solution and in buffered solutions at pH 4.40 and at 6.38) compared to those of normal epidermis and the hyperplastic epidermis following application of methylcholanthrene.

Three photomicrographs; 3 tables.

Life Span of White Blood Cells as Measured in Irradiated Parabiotic Rats. Donald C. Van Dyke and Rex L. Huff. Am. J. Physiol. **165:** 341–347, May 1, 1951.

Several methods have been employed in attempts to determine the rate of production or the survival time of the various white blood cells. The plan of the present experiment was to stop production of leukocytes in one member of a parabiotic pair of rats by irradiation and compare the resulting concentration of the various white cells in the blood of the two animals. Single rats treated in the same way served as controls. Radiation factors were: 200 kv., 15 ma., filters of 0.5 mm. Cu and 1.0 mm. Al; tube distance 15 inches. The time necessary to deliver the desired dose was determined with ionization chambers in a plastic phantom. It was determined that at a dose of 950 r the so-called non-irradiated rat received 28 r. Total white cell counts were made daily on the pairs and on the single control animals.

The irradiated rat was found to maintain a low level of leukocytes in the circulation as the result of the blood received from the normal member of the pair through the vascular anastomosis. The amount of blood exchanged by such animals was measured and from this the total number of leukocytes introduced into the blood of the aleukopoietic member was calculated. The relation between the number of leukocytes introduced into the blood stream and the level of the leukocytes maintained in the blood stream allowed calculation of the average life time of the leukocyte in the blood vascular system. These studies indicated that the average survival time of the mononuclear leukocytes in the blood of an irradiated parabiotic rat was 170 minutes while the average survival time of the polymorphonuclear leukocyte was 23 minutes. Myeloid elements of the blood are replaced seven times as frequently as the lymphocytes.

Two illustrations; 2 tables.

Observations on the Skin Reaction to the Subcutaneous Application of Metallic Polonium in Mice. Leiv Kreyberg and Finn Devik. Acta radiol. **35:** 356–362, May-June 1951.

Three series of mice were exposed to a nickel plate covered with polonium introduced surgically beneath the skin for intervals varying from twenty seconds to thirty minutes. Histologic studies twenty-four hours, sixteen days, and twenty-six days later, as well as autoradiographic studies, suggested that polonium was dissolved in the tissue fluids and produced general and local radiation damage. There was noted following the subcutaneous implants a marked stromal vascular reaction not observed on external applications of the polonium-coated plate (see Devik: Acta radiol. **35:** 149, 1951. Abst. in Radiology **58:** 159, 1952), as well as hyperplastic skin epithelial changes in contrast to slight atrophy with external application.

The authors favor the theory that irradiation produced in the manner described above has an indirect effect through the connective vascular system to produce marked hyperplasia of the skin.

Seven illustrations.

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Effect of Thyroid Hormone on Radiation Lethality. Willie W. Smith and Falconer Smith. Am. Physiol. **165:** 639–650, June 1, 1951.

It is important to learn by what means and to what extent the sequelae of radiation can be altered by treatment instituted shortly after irradiation. Thyroid hormone administered during this period increases radiation lethality (Blount and Smith: Science **109:** 83, 1949), and such an effect is useful in bringing to light certain characteristics of the changing state of the animal during the critical time between irradiation and recovery or death.

In the experiments described here, an analysis of the relationship between radiation dosage and mortality in a large series of untreated mice was made, to serve as a basis for estimating the magnitude of the thyroid effect in terms of roentgens. A critical period (between seven and fourteen days) was found for the thyroid effect relative to the time of irradiation. More definite localization would require further study.

Survival times of control and thyroid-treated mice that died following irradiation were compared. In the paired experiments 123 control males died with an average survival time of 11.35 ± 0.34 days, and 318 males given thyroid from immediately after irradiation died with an average survival time of 11.37 ± 0.21 days. The corresponding values for females are 13.1 ± 0.44 days for 88 controls, and 12.3 ± 0.29 days for 191 thyroid-treated animals. Although the percentage of deaths was more than twice as high among the thyroid treated mice, their survival time was not shortened. Increasing the radiation dose between 325 and 500 r also failed to shorten survival time. At doses of 600 to 700 r, where mortality was 90 per cent or more, the mean survival time was slightly shortened. With respect to survival time, the thyroid effect is indistinguishable from increased radiation dosage, further justifying expression in terms of treatment equivalent roentgens (t.e.r.). The quantitative estimate of the thyroid effect was 95 r ± 13 r.

Dinitrophenol was found to increase the proportion of deaths after irradiation. Thiouracil and propylthiouracil failed to protect against radiation lethality. A yeast supplement failed to prevent thyroid from increasing the mortality after irradiation. Weights of adrenal, lymphoid tissue, and kidney were determined and blood studies made in thyroid-treated and control irradiated mice. No evidence was found to indicate that the thyroid effect is secondary to its action on the adrenal. After sublethal irradiation, leukocytes and hemoglobin were more depressed in thyroid-treated than in control mice.

Three charts; 6 tables.

Effects of Thyroid and Radiation on Sensitivity to Hypoxia, Basal Rate of O_2 Consumption and Tolerance to Exercise. Willie W. Smith and Falconer Smith. Am. J. Physiol. **165**: 651–661, June 1, 1951.

During experiments pertaining to the effect of the thyroid hormone on radiation lethality it became evident that more knowledge was needed concerning the physiological effects of thyroid on both normal and irradiated mice. Several manifestations of thyroid action were studied in a search for evidence of relative independence from the thyroid effect on basal O_2 consumption. These effects were compared with effects of radiation, and irradiated animals given thyroid were studied for evidence of thyroid potentiation of specific radiation effects. The possibility was tested that radiation might cause an increase in the incidence of cardiac failure brought on by exercise in thyroid-fed mice.

Increased basal O_2 consumption, increased sensitivity to progressive hypoxia, and decreased tolerance to exercise were found to follow the same course of development in time. After irradiation no increase in basal O_2 consumption was found, and sensitivity to progressive hypoxia was decreased. After 325 r there was no decrease in tolerance to exercise within the limits of the test. Thyroid administration superimposed upon radiation resulted in no increase in basal O_2 consumption beyond that caused by thyroid alone. Resistance to progressive hypoxia was greater than with thyroid alone. Exercise was tolerated almost as well as it was with thyroid alone. The large number of early failures and deaths of thyroid-treated mice during the exercise test is believed to indicate defective functional capacity of the heart rather than general fatigue.

Six charts; 3 tables.

Exercise Effects on Tolerance to Radiation. Falconer Smith and Willie W. Smith. Am. J. Physiol. **165**: 662–666, June 1, 1951.

The mechanisms associating metabolic rate and radiation lethality are of fundamental importance in the physiology of animals during the first weeks following whole-body irradiation. In an attempt to determine whether increased oxidative metabolism resulting from forced muscular activity is similar in effect to that produced by substances which increase the basal metabolic rate (see preceding abstract), the authors studied the effects of exercise in mice following irradiation with 400 to 600 r. Physical factors were: for three experiments, 170 kv., 20 ma., 0.25 mm. copper and 0.55 mm. aluminum added filtration, 50 cm. target distance, 62 r per minute; for two experiments, 200 kv., 20 ma., 0.08 mm. copper, 50 cm. target distance, 114 r per minute. The exercise was given in cylindrical mesh cages 48 cm. in diameter revolving at a peripheral speed of 270 meters per hour. When the cages were rotating the mice either walked rapidly forward and rode back with the cage, walked steadily, or clung to the mesh of the cage for entire revolutions.

As a whole, the effect of moderate exercise eight consecutive hours a day, or of twelve hours a day in equally spaced periods of three hours, was to decrease only slightly, if at all, the tolerance of mice to whole-body irradiation. After a radiation dose which was 100 per cent lethal, 7 out of 30 mice failed to tolerate three consecutive days of exercise for eight hours per day. Those surviving the exercise period showed no difference in survival time from their irradiated controls. Phenobarbital sedation after irradiation failed to increase the radiation tolerance of mice. The authors conclude that radiation lethality does not parallel rate of O_2 utilization under the conditions of their experiments.

Two tables; 1 chart.

Lymphoid Lesions in Poliomyelitis. Sheldon C. Sommers, Joan C. Wilson, and Frank W. Hartman. J. Exper. Med. **93**: 505–512, May 1951.

The authors report that in the examination of 50 autopsied cases of human poliomyelitis the most frequent pathologic change save those found in the central nervous system was a hyperplastic and inflammatory change in the lymphoid tissue.

Because of these prominent lymphoid changes, the authors carried out experiments with mice, which they treated with agents damaging to lymphoid tissue prior to exposure to the poliomyelitis virus. The lymphoid tissue-damaging agents used were x-ray irradiation of the whole body, aminopterin, and ACTH. In the mice treated with these agents an increased incidence of poliomyelitis infection was found, which was ascribed to the damage to the lymphoid tissues experimentally produced. The authors feel, on the basis of combined morphologic and virus studies, that the presence of gastro-intestinal lymphoid nervous tissue and nerve cell defense barriers to poliomyelitis virus exist. They point out that the use of irradiated mice might prove useful in the primary isolation of virus from human poliomyelitis.

Six photomicrographs. D. S. CHILDS, JR., M.D.
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Effect of Roentgen Rays on Microsporum Canis. An in Vitro Study. Kurt Loewenthal. Arch. Dermat. & Syph. **63**: 750–758, June 1951.

An investigation was made to determine the effect, if any, of a moderate dose of x-rays on the faculty of fuseaux formation of *Microsporum canis, in vitro.* Fuseaux are the multichambered, spindle-shaped macroconidia characteristic of some species of *Microsporum.* Two freshly isolated strains of *M. canis* were used for the study, one with inconstant and weak fuseaux production and the other with the capacity to form abundant fuseaux. A single exposure of 300 r, unfiltered, was given, since this dose approximates that generally employed for epilation of certain *Microsporum* infections of the scalp. It was found that while the irradiated colonies remained free from gross and microscopic changes some of their descendants exhibited various and variable phenomena. These phenomena consisted primarily in pleomorphic degeneration and massive deterioration of the fuseaux formation. Presumptive evidence that these changes were the result of the irradiation is based on the following facts: (1) the degeneration phenomenon occurred in two experiments and the massive degeneration in four out of five experiments; (2) both recurred in successive generations of colonies; (3) both were absent in the respective control colonies. Since occasional and rare distorted spindles could be detected in a few control colonies, and since pleomorphism is a "normal" event in the life history of *M. canis,* it is believed that the biologic downward trend of an aging strain was intensified and accelerated through x-ray irradiation.

Four figures.